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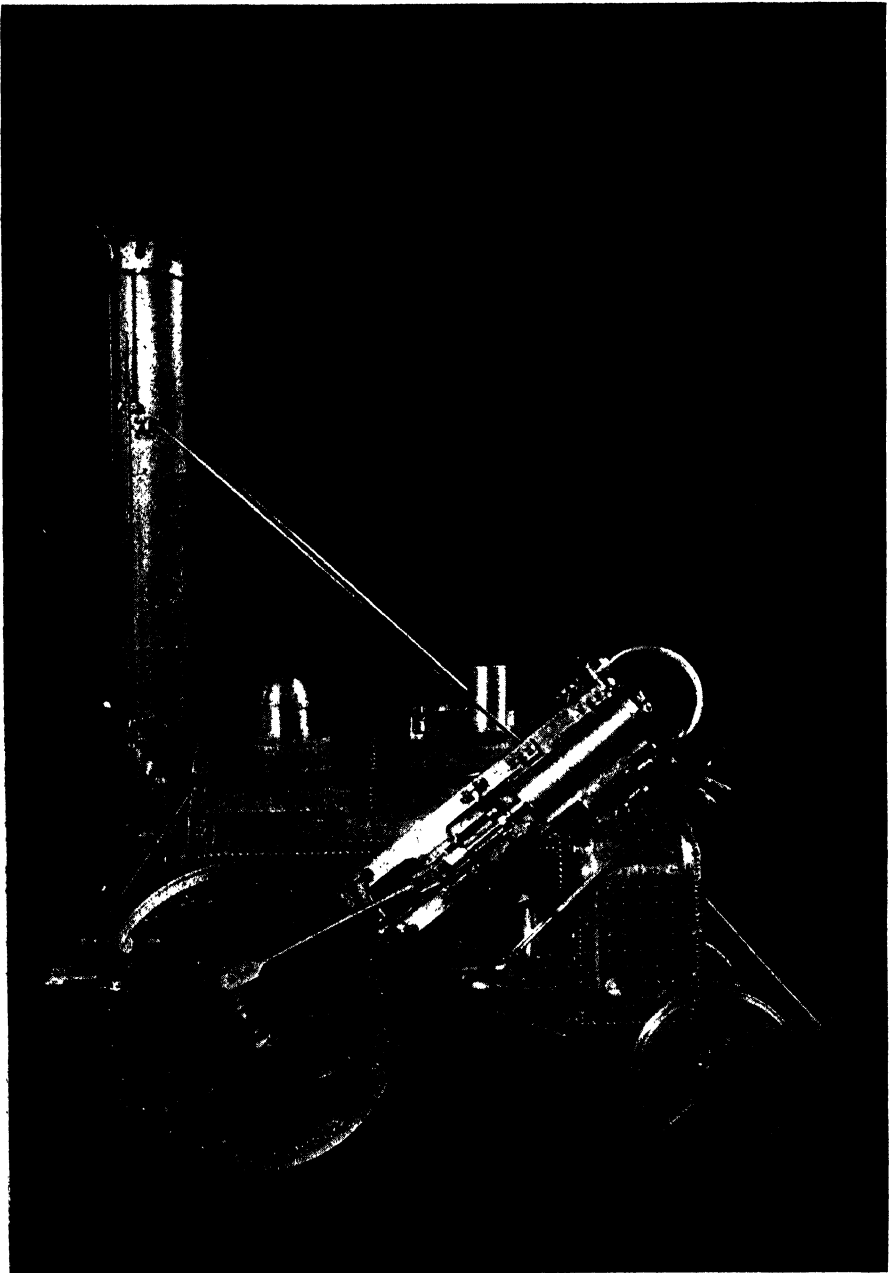
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MECHANICS IN MINIATURE



THE SILVER "ROCKET"

A perfect scale model of Stephenson's famous locomotive. Built, mainly in silver, by Dr. J. Bradbury Winter, for presentation to the Institution of Mechanical Engineers. Scale $\frac{1}{4}$ in. to the foot.

MECHANICS IN MINIATURE

*The romance of the fascinating and instructive hobby
of model engineering and the activities of its many
adherents at home and abroad*

By

PERCIVAL MARSHALL

*Companion of the Institution of Mechanical
Engineers, Past-President of the Society of
Model and Experimental Engineers, Founder
and Editor of "The Model Engineer."*



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PREFACE

A remarkable vision of handicraft skill, of ingenuity, and of happy occupation is conjured up by the title I have chosen for this work.—“Mechanics in Miniature.” What kind of work does it include? What kind of people pursue it as a hobby? What are their rewards in health, recreation, and the advancement of technical knowledge? These are the questions I have endeavoured to answer in the pages which follow.

A little over forty years ago, when I contemplated launching THE MODEL ENGINEER on its adventurous voyage, I called on a firm in the heart of London who, in addition to general engineering repair work, supplied some of the then existing model engineers with tools and castings for the purpose of their hobby. This was a side-line to their general business, and, in conversation with the principal, I gathered that very little importance was attached to this trade. When I explained my intention to publish a journal for model engineers, I was told, “You’ll be lucky if you sell 500 copies, model engineering is dying out.” Undeterred by this discouraging reception, I went ahead with my plans and, in due course, lighted the torch of a most fascinating hobby, which has since spread the world over, wherever the English language is read and spoken. By the irony of Fate, that pessimistic engineering firm has ceased to exist, whereas THE MODEL ENGINEER has achieved a circulation of many thousands of copies every week, and has brought interest and encouragement to a remarkably numerous family of devoted readers.

Looking back over this period of nearly half-a-century, I have been deeply impressed by the inherent mechanical skill of the British race. My readers have included people of all ages and the most diverse occupations and social positions, and yet, in all of them, there has been an inborn love of good craftsmanship for its own sake, and a desire to give expression to the thoughts in their minds through the employment of their hands. Through the hobby of model engineering, thousands of people have found a means of healthful recreation, as well as an outlet for a natural love of things mechanical, which has not been afforded to them by their normal occupation. The ability to make interesting models is not confined to any one class, nor is it restricted to those who have received professional training in engineering, or in any branch of workshop practice. Indeed, some of the most beautiful examples of workmanship I have seen have been produced by those who have been entirely self-taught in their engineering knowledge and in their skilful use of tools.

Model engineering, which in general terms may be defined as engineering in miniature, has kept pace with the progress of invention and discovery. The developments of engineering design and construction are mirrored in the productions of the model engineering workshop, and a survey of the contents of the ninety and more

volumes of *THE MODEL ENGINEER*, which have now been published, would parallel the records of progress in the real engineering world. So much public interest in the work of model engineers has been aroused by exhibitions and in other ways, that I have thought a book setting out the various aspects of the hobby, and giving some examples of notable work accomplished, would be generally welcome. I have, therefore, prepared the present volume, which I hope will be of interest to all who have felt the fascination of a world in miniature, or who have a well-founded appreciation and understanding of fine craftsmanship and mechanical ingenuity. It may help to remove the impression, which still exists in some quarters, that model engineering is merely a pastime for boys, and a waste of time and effort for its older followers. Although mainly regarded as a hobby, model engineering has done much to stimulate profitable invention and research. It has, moreover, developed handicraft skill to such an extent that in times of national emergency thousands of model engineers have been able to go into industry or the armed forces and contribute valuable service in the making and repair of tools, gauges, and instruments of precision. These hobbyists in fact form a reserve of mechanical skill which has proved of untold value to the nation.

There is one other aspect of the hobby to which I should like to refer, and that is the sociability and mutual good-will which is so apparent, whether in club life or among detached enthusiasts. This is probably true of many hobbies, but a common interest in model making is a sure passport to acquaintance, and in many cases, to a valued friendship. This has been exemplified over and over again, and the lives of many people have been brightened by the contact with kindred spirits brought about by interest in their mutual hobby.

The illustrations in this book show how extraordinarily diverse are the activities of model engineers, and in many instances how skilfully and how ingeniously they approach their work. Most of the illustrations tell their own stories. I have thought it well to use a large number of individual pictures which in themselves convey information and inspiration, rather than to burden the text with the technical details of a more limited range of models. In this way a much broader survey of the hobby is possible, and the reader will more readily grasp the truly remarkable implications of a love of mechanics in miniature. Although some of the photographs illustrate magnificent examples of craftsmanship, I have included a few less ambitious efforts in order that the prospective model engineer may not be unduly alarmed by the elaboration of the work illustrated, and may not feel that the hobby is beyond his personal skill or his pocket. I would like to express my cordial thanks to all those who have kindly allowed me to illustrate their work, and to hope that the publicity thus given to their efforts may be regarded as an additional measure of appreciation of their contribution to the cause of model engineering. It is worth emphasising that all the models and other productions illustrated have been made in home workshops, many of which are very modest in their size and equipment. The great majority of the models are the work of strictly amateur mechanics ; a few are the work of enthusiasts who have had professional engineering training, but have found pleasurable recreation in pursuing their love of craftsmanship in their own way in their spare time hours.

I have not included the work of commercial model makers, much of which is of a very fine and impressive character, and would easily fill another book. I think, however, the work of the hobbyist is even more remarkable. It is in many cases equal to the best professional standard, and in point of variety and human endeavour is of much greater interest.

Finally, I would explain that this is not a book intended to teach its readers how to make models. It is a general survey of the possibilities and diverse range of subjects provided by the hobby, so that the newcomer may choose an avenue of approach which will prove of interest and be within his grasp. Ample details of constructive procedure will be found in other handbooks and in blue-print designs which are readily available for his guidance.

London.

PERCIVAL MARSHALL.

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EARLY MODEL ENGINEERING

Its History and Growth

THE art of model making is centuries old. The fascination of things in miniature, and the urge to fashion bits and pieces of material into representative shapes has existed since time began. The Chinese have always been noted for their skill in the carving of ivory, and as being the true experimental pioneers in certain fields of invention. The Japanese have achieved fame for their miniature gardens and landscapes and in many forms of patient craftsmanship.

In the ancient tombs of the Kings which have been opened up in Egypt, beautiful models of boats, vehicles, and furniture have been found. The model maker of ancient days naturally received his inspiration and his guidance from the objects and devices which he observed in his daily life. They were the prototypes which he reproduced in miniature, or to which he applied his inventive skill. The last century and a half has been the era of the engineer and therefore it is not surprising to find that during this period the same urge to engage in craftsmanship in miniature has been made manifest in models of every variety of engineering achievement.

Art, Music, and Mechanics

The term model engineering covers a multitude of interests. It is a compact and expressive title which includes the application of craftsmanship to the reproduction in miniature of engines, machinery, ships, aeroplanes, vehicles, buildings, and mechanical devices and inventions of every kind. Optical and scientific instruments, electrical and experimental appliances, and even musical instrument making come within its range. It is a curious fact that skill in pictorial art and music are often found to be linked in the same individual with a love of mechanics. I attribute this to the creative urge of the artist. Through his hands he can give expression to the workings of his mind, whether

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**A proud model locomotive builder of the
Mid-Victorian era.**

on the canvas, or on the keyboard, or in the workshop. He sees or hears his thoughts taking actual shape, and he is mentally and spiritually content. For example, Sir Walter Alcock, the distinguished organist of Salisbury Cathedral, has been a life-long model engineer. Many years ago he showed me a splendid working model of a Midland locomotive, which he had built at his then home in Chelsea. I remember a characteristic instance of his desire that his model should be true to type. I asked him how he got his dimensions ; did he work from drawings ? He smiled, and said that he had no drawings, but when he needed a particular dimension, he would go to St. Pancras Station when he

knew the original engine was standing at the platform and measure it up with his umbrella. He knew, of course, that a certain mark on the umbrella stick represented so many inches from the tip, and thus he got the size he wanted, much to the mystification and amusement of the driver. Another clever model engineer, Mr. C. H. Clarke, has built a really beautiful organ for his private house. This was a labour of love through a period of several years, and it has been well rewarded by the pleasure of playing the completed instrument. The late Mr. H. G. Riddle, for many years the Secretary of The Society of Model and Experimental Engineers, turned to music and built himself an organ, after equipping his house with a complete electric lighting plant of his own design and construction. Mr. A. J. Lamb, the Honorary Treasurer of that Society, makes a hobby of horology, but as a relief from the concentrated attention of his workshop hours, finds organ playing an agreeable and inspiring change of interest. The leader of a well-known orchestra in Switzerland has one of the best equipped model engineering workshops within my knowledge, and a

Artists and Model Makers

teacher of the violin often used to tell me of the value of model making as a relief from the monotony of repeatedly giving the same instruction to his pupils. On the pictorial side, I call to mind the late Mr. H. R. Millar, whose charming illustrations to fairy tales in books and magazines delighted both old and young for many years. As a locomotive builder he was equally artistic, his models ranking very high in their accurate portrayal of their full-size prototypes. Mr. Arthur Drummond, the founder of the well-known firm of machine tool builders, achieved fame as an artist before he laid aside his brush to create the remarkably popular lathe which became an outstanding feature of so many model engineering workshops. Mr. René Bull, another distinguished artist in black-and-white, was equally devoted to the model locomotive hobby, while the late Mr. K. M. Morrison, a delightful painter in water-colour, found his mechanical recreation in the collection and re-conditioning of models of old time engines. Mr. Herbert Teague, one of the pioneers in model speed boat construction, was a well-known member of the artistic community in Florence, and he aroused much public interest by the demonstration of his ingenious model speed boats on the local river Arno. These are a few only of the many instances known to me where artistic and musical tastes and ability have found expression in parallel with an inherent love of tools and mechanical occupation. While this dual love

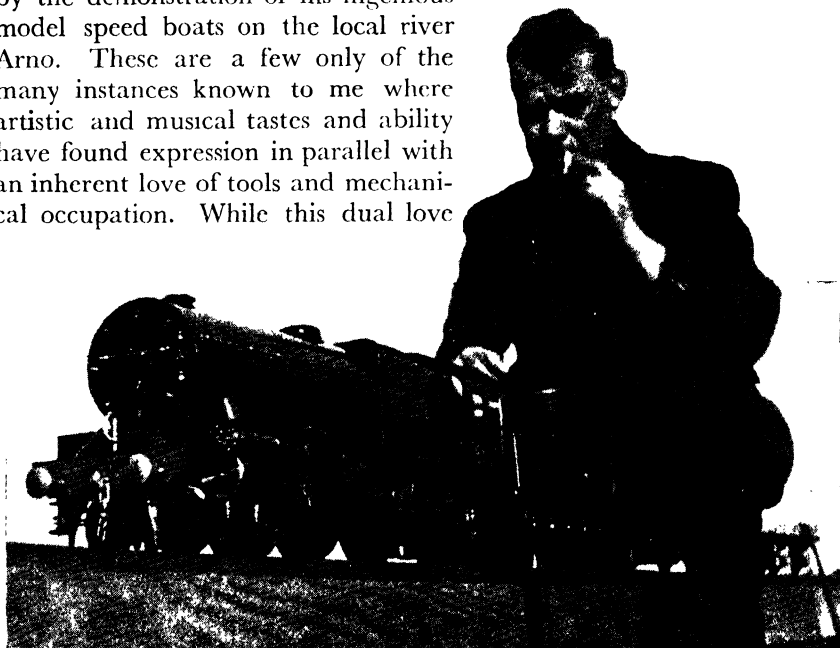


Photo by]

The modern locomotive modeller prefers "live steam." Here is Mr. S. C. Wade driving his fine 3½-in. gauge model of the "Royal Scot."

[A. Galeota

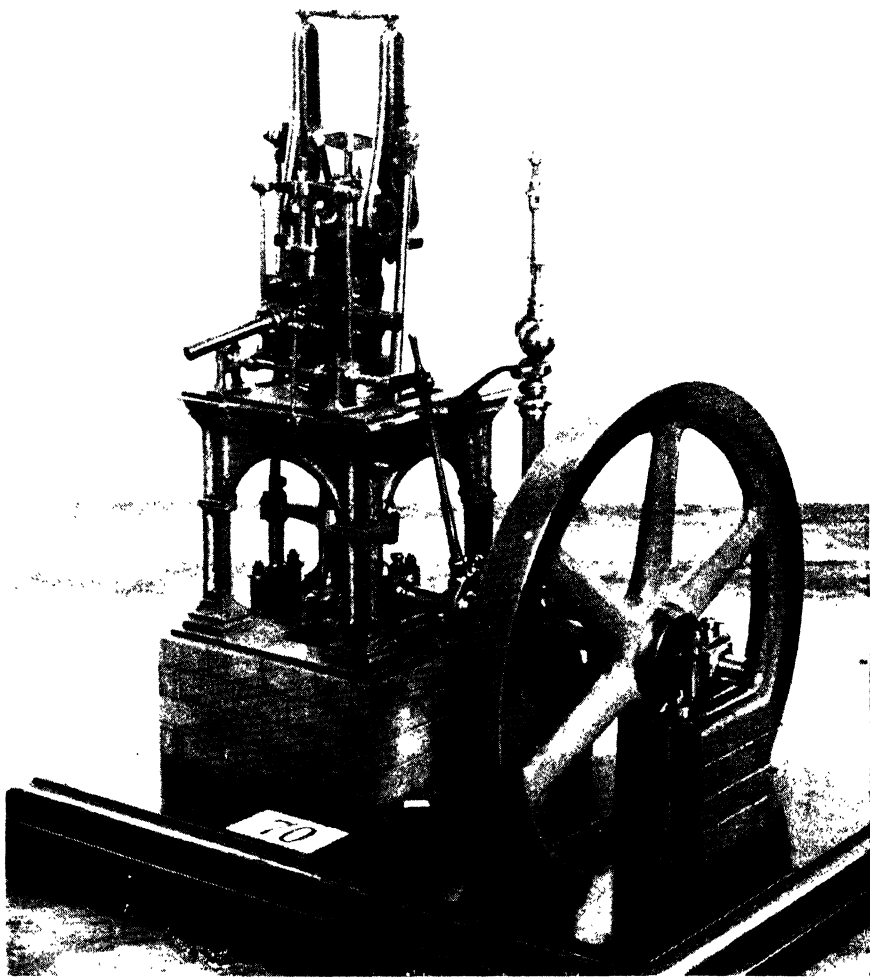
Early Model Engineering

of art and mechanics undoubtedly exists in many people, it is, of course, by no means universal. I think, however, it is true to say that there is something of the creative artist in every model maker.

Ornamental Turning

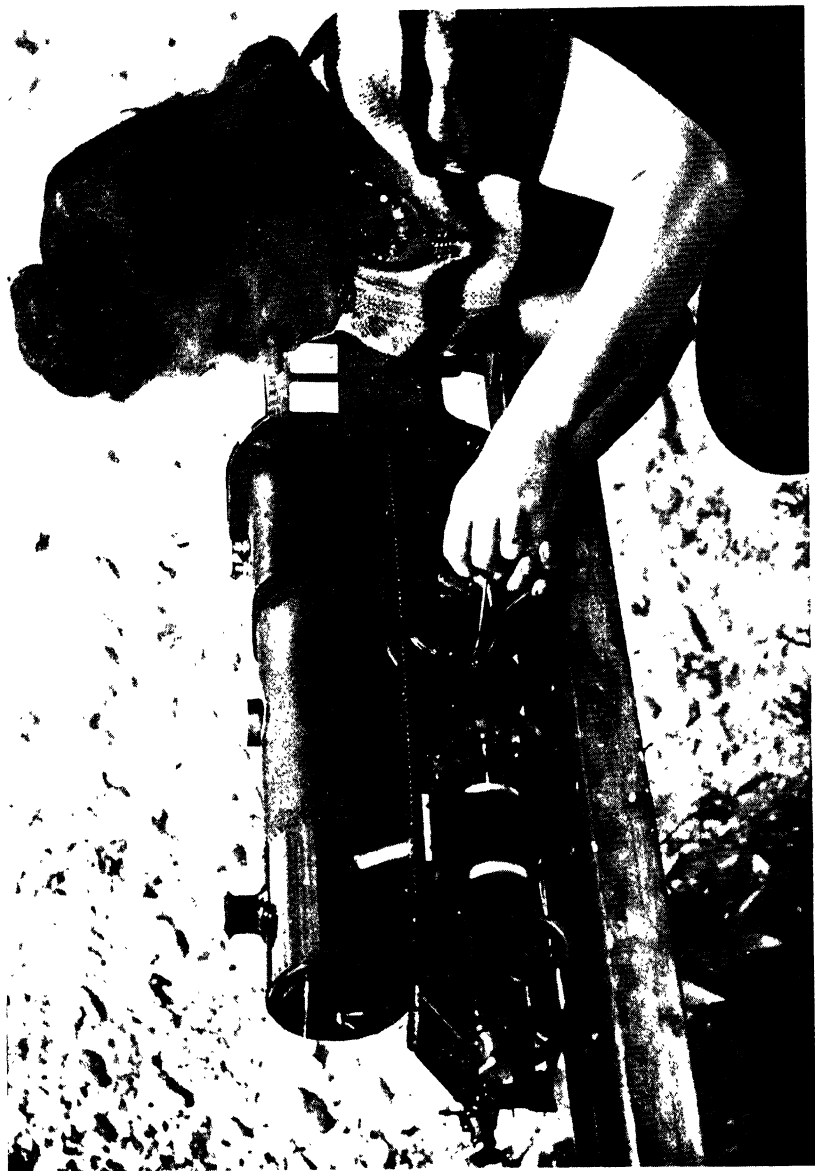
After this little digression into the relationship between artistic and mechanical ability, let me revert to the story of the development of our hobby. Before the modern world became mechanised by the engineer, mechanical craftsmanship had to find an outlet in other ways. The Swiss and the French people have always been famous for their skill in watch and clock making, and in the construction of musical boxes and mechanical toys and novelties of a very ingenious nature. In the 18th and 19th centuries, the French also showed considerable interest in the art of ornamental turning, and the lathe was a familiar item of workshop equipment with many small industrialists, and in the private houses of the well-to-do. Later, in our own country, ornamental turning found many followers, particularly during the Victorian era, and it is interesting to recall that it was very popular with clergymen and retired service officers. The beautiful precision lathes sold by Holtzapffel, Evans, Hines and other makers found ready purchasers, expensive though they were, and gave great pleasure and interesting recreation to their fortunate possessors. Ornamental turning was principally carried out in ivory and fancy woods, and many lovely designs for vases, candlesticks, caskets, and picture and mirror frames were evolved and executed in those materials. The beauty of the work consisted not only in its graceful outline, but in the great variety of decoration by way of artistic spiral, eccentric, fluted and other patterns machined on the surface of the material, the combination of woods of different colours, and the inlay of turned medallions, all of which variations the ornamental lathe with its many attachments made possible.

Ornamental turning was fostered for many years by one of the London City Companies, the Worshipful Company of Turners, who held an annual exhibition of examples of turned work, at which medals and other prizes were awarded. The Company also encouraged lathe work in wood and metal, and made a special feature of competitions for industrial apprentices to the craft of wood turning. The operation of the ornamental turning lathe could not strictly be regarded as a handicraft, since it called for little or no skill in the manipulation of hand tools. The lathe itself was a machine which did the work, but it was a very elaborate machine and required considerable investigation and understanding properly to appreciate its possibilities and the correct application



A MODEL "TUXFORD" TABLE ENGINE

This dainty miniature model, constructed by Mr. H. A. Braithwaite brings back memories of the days when engineers were allowed to be artists as well as craftsmen

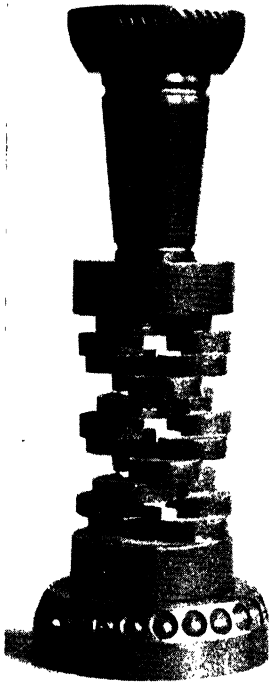


$\frac{1}{2}$ -in. SCALE MODEL LOCOMOTIVE "MARINA"
Made by a lady model engineer, Mrs. M. A. Austen-Walton



Sometimes the modern constructor dips into the realms of history. Mr. W. Finch demonstrating his model "Rainhill" under steam.

of the attachments and cutters required to produce a particular shape or pattern. In this way it afforded a very attractive hobby for those who had a liking for tools and for mechanical operations, as well as an artistic sense of beauty of form and line. Ornamental turning has very largely gone out of fashion, but here and there an enthusiast still pleasurably explores its possibilities. There are few, if any, such lathes made nowadays, but one can occasionally be bought at second-hand, and, if in good condition, may be a very interesting acquisition. These lathes were invariably of the highest grade in their mechanical accuracy and finish, and the various chucks and accessories embodied very considerable ingenuity and geometric knowledge. The name of Holtzapffel will long be remembered, not only for the perfection of the tools he made, but for his classic work on *Turning and Mechanical Manipulation*, published in six volumes, in 1847. In its sub-title, this book is described as a "work of general reference and practical instruction on the lathe and the various mechanical pursuits followed by amateurs." The volumes are long since out of print, but if any amateur mechanic comes across a second-hand copy of the book, or any of its separate volumes, he will find it to be a veritable mine of workshop knowledge,



An example of ornamental turning in fancy woods, by Mr. A. P. Drake.

particularly Volume II, on the basic principles of cutting tools, which hold equally good today. It contains the experience and advice of an acknowledged master mechanic. As an example of the completeness of his handicraft tuition, I would refer to one section of Volume II, which gives very meticulous instructions for filing a flat surface. This is a workshop test in itself. If an amateur can produce a truly flat surface with a file he may account himself a good mechanic. There are many so-called professional mechanics who would find this task beyond their skill. This is no doubt due to the wide introduction of milling and grinding machines into industry, which obviate the necessity for skilful use of the file in the accurate fitting of engine and machine parts.

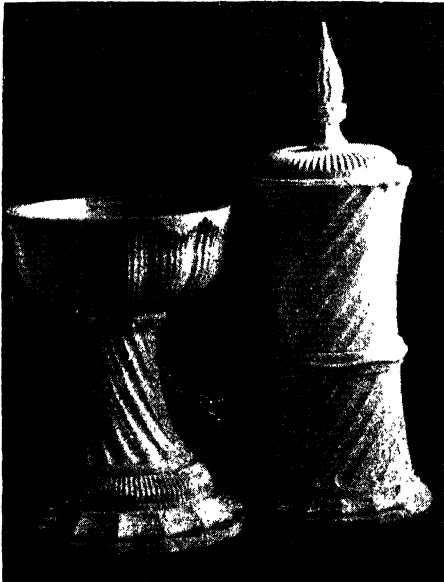
I have referred at some length to the subject of ornamental turning because, although it is not directly a branch of model making, it did for many years represent the chief interest of the amateur who had a fondness for the recreation afforded by a workshop. Indeed, the hobby was so attractive that it formed the principal reason for the formation of The Amateur

Mechanical Society, a body long since extinct, but which was, in effect, the forerunner of the many model engineering societies which exist today. While this enthusiasm for ornamental turning was still in vogue, engineers were inventing and building locomotives, marine engines, traction engines, mill engines and machinery of all kinds which appealed very strongly to those with mechanical tastes. The desire to reproduce some of these triumphs in miniature gradually replaced the wish to make beautiful vases and candlesticks, articles which, however pleasing to the artistic mind, were of little practical value, and moreover, they did not work. The fact that a well-made model locomotive or other engine actually works has a great deal to do with the attractions of model engineering.

Historical Models

Historical Models

During the last century quite a number of model engines were built by isolated workers, some of them professional engineers or instrument makers, others amateurs who had the urge for engineering work in their blood. From time to time one of these old-time models comes to light as a family heirloom, or, perhaps, as a plaything long since relegated to the lumber in the attic. When built by a competent mechanic and based on the engineering practice of the day, these old models have an historical value, and are much sought after by collectors. Some model engineers who come into possession of an "old-timer" find considerable interest in checking the details of its design and construction with existing records of early engine building practice, and, where necessary, in reconditioning details which may be



Showing the decorative effect of fluting and spirals on ornamental ivory vases, by Mr. A. P. Drake



An effective vase in ebony with ivory decorations, by Mr. A. P. Drake.

faulty or in restoring parts which may be missing. The late Mr. H. O. Clark, a President of the Norwich Society of Model Engineers, was a notable enthusiast of this kind, and he acquired a really remarkable collection of old models which are of very great historical interest. He devoted a considerable amount of time and engineering knowledge and skill to bringing these models not

Early Model Engineering

“up-to-date” but “back-to-date,” and he was rightly very proud of his collection, which I think is, without doubt, the best private assembly of its kind in the country. It is now a treasured possession of Mr. Clark’s family. His son, Mr. Ronald H. Clark, himself an engineer, is also a collector, and the continuance of the Clark tradition will be worthily maintained. One remarkable item in this collection is a model of an engine with a *square* piston, no doubt the dream of an inventor not too well informed on the true principles of engine design. Dr. R. L. Robinson, the late Captain R. Alston, and the late Mr. G. F. Tyas are other instances of model engine collectors who have exercised the same discriminating knowledge in acquiring and restoring some of these old time treasures.

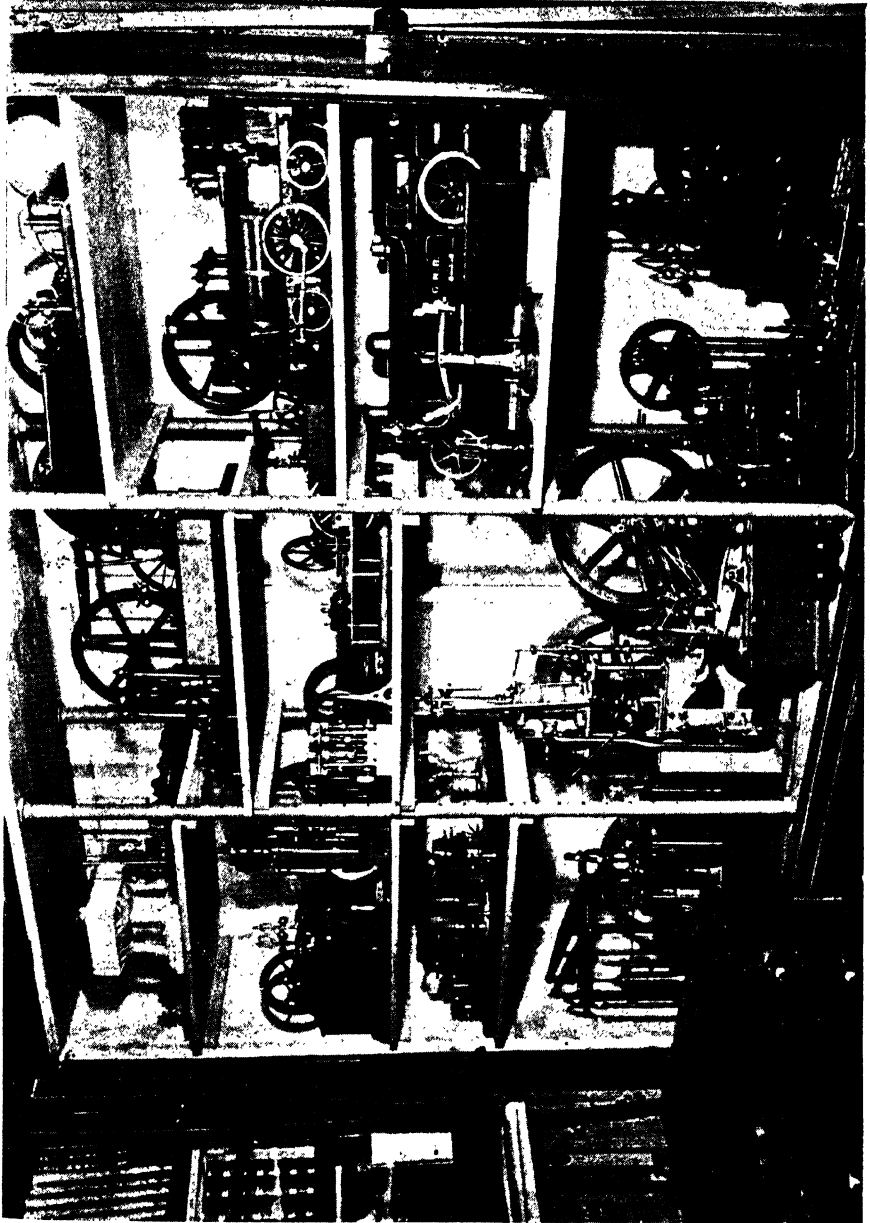
James Watt as a Model Maker

A very early engineering model which has acquired undying historical fame was the model of a Newcomen engine, entrusted by the Glasgow University to James Watt, in the year 1763, for repair. It was while cogitating over this model that Watt conceived his epoch-making invention of the separate condenser, a departure in design which was the real starting point of the efficiency and power of the modern steam engine. In effect, it enabled boiler steam pressure to be applied to the piston, instead of atmospheric pressure, and as boiler construction improved, and working steam pressures rose, so engines became more powerful, with the accompanying advantages of very considerable reduction in the size of the cylinder and the general design of the engine, and a vastly increased speed of revolution. It will thus be seen how great was the part played by a model in the early development of the steam engine and in the application of steam power to industry.

The founding of “The Model Engineer”

From these brief historical notes it will be gathered that the practice of model engineering and the love of mechanical recreation is no new thing. Private workshops existed, models were made, a few articles on model making appeared occasionally in popular scientific journals, and even a few books on model engine making were published, prior to the founding of *The Model Engineer*. But the hobby itself and the literature connected with it were both of a very spasmodic and scattered nature. There was no specialised organ which catered specifically for the model builder, from which the amateur engineering enthusiast could derive a regular flow of inspiration and instruction. Then *The Model Engineer* was launched, in 1898, to gather these threads together and put life into what appeared to be a genuine but somewhat stifled need of

Mr. H. O. Clark's Collection



A section of the late Mr. H. O. Clark's extensive collection of historic engineering models.

Early Model Engineering

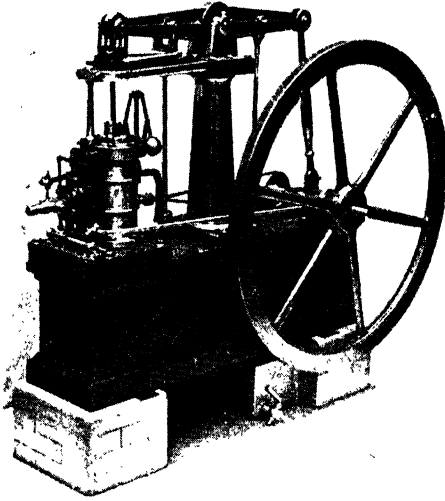
the times. Its success was instantaneous, the demand exceeded the supply, and the first two issues had to be reprinted to satisfy those who forthwith decided to have complete volumes on their shelves.

In planning the scope of *The Model Engineer* I was actuated by two motives. One of these was, as already explained, to provide a collecting point for the interests of model engineers and a regular record of their activities. The other, and I think not less important purpose, was to give real engineering knowledge and guidance to model engineers to aid them in raising the standard of their productions. As an engineer I had been very unfavourably impressed by the old-fashioned design of the locomotives and other models displayed in the windows of many shops of opticians and instrument makers, and also by the equally out-of-date nature of the sets of castings then being offered to the model maker by the one or two firms in the supplies trade. I felt that something should be done to place before model engineers designs and instructions more worthy of their ability and their energies. I realised that many would-be model engineers had no great knowledge of real engineering practice and were, therefore, unable to direct their efforts into the production of models which would satisfy the eye of the trained engineer and so bring about a better understanding and appreciation of their hobby. The result of this policy over a long period of years has been remarkable. The designs, castings, and materials offered by trade firms have improved out of all recognition and a race of amateur model makers has grown up whose skill, ingenuity, and technical knowledge in many cases reaches the standard of the professional worker. Concurrently with the progress of the amateur, many professional engineers and mechanics have been attracted by the fascination of miniature work and have enriched the hobby by the quality and variety of their leisure-hour productions. Lone enthusiasts have, through the pages of *The Model Engineer*, and at exhibitions, been able to compare their efforts and their methods with the work of other hobbyists, and have gained both increased incentive and much practical workshop knowledge therefrom. This advantage has been intensified in many cases by taking up membership of one or other of the large number of local model societies and clubs which the journal has assisted in founding.

Why People Make Models

It is an interesting speculation to enquire why a model engineer first began this hobby, or why he decided to build a particular model. If you put these questions to a hundred different model engineers you might receive a hundred different answers, but they would all come back

Why People Make Models



A model beam engine re-built by Mr. H. O. Clark from a collection of "bits and pieces" discarded long ago by the owner. Cylinder, 1½ in. × 2½ in. Bedplate 15 in. long. Date 1840.

to the one basic starting point of the urge to employ the hands in making something, or, what is much the same incentive, the need for a hobby which would afford a light, interesting, and instructive occupation, to provide agreeable recreation from more strenuous daily work, or to relieve boredom in the years of retirement. Admiration for a particular ship or locomotive, the sporting adventure of running model speedboats or racing-cars, the thrill of driving one's own steam locomotive on a garden railway track, the excitement of flying model planes, or the simple love of handling and using tools and machines; all these things have inspired the founding of a home workshop

and have resulted in many hours of happy interest.

I remember one model engineer who found in his scrap-box a piece of tube which he thought looked exactly like the funnel of a traction engine. He fitted a copper ring to the top and was still further impressed with the reality of the effect. He decided to build a complete traction engine, incorporating his funnel, and accomplished this most successfully. Another enthusiast was in the saloon bar of a hotel, when he saw an ash tray, an advertisement for a well-known motor car tyre. The tray was fitted with an imitation tyre. He looked at this admiringly and thought how well such miniature tyres would look on a model of a motor car. He built the car. The father of a family one day idly picked out a small piece of red modelling wax from his daughter's school box. He rolled this to-and-fro in his fingers and was suddenly struck with the resemblance of the little ball of wax to a tomato. He made another, and before long he had a little pile of miniature tomatos on the table. This set him thinking about making other vegetables and fruit from similar materials. He developed this idea with so much interest that he built a model of a fruiterer's shop, stocked not only with garden produce, but complete

Early Model Engineering



Photo by]

Dr. R. L. Robinson, a notable collector, with some of his interesting models of historic locomotives.

[Fox Photos Ltd.

with counter, shelves, scales, baskets and all the appurtenances of an up-to-date retail establishment. He brought this to one of *The Model Engineer* Exhibitions, and encouraged by the great interest it aroused, he carried on with his very special hobby, and built several other models, including a confectioner's shop with the window full of attractive cakes and pastries, and a musical and radio shop stocked with all kinds of miniature instruments and wireless receiving sets. This was, perhaps, not strictly model engineering, but it illustrates the clever application of finger-craft in an enjoyable way.

Many years ago I was much interested to receive a photograph of an imposing looking model of a traction engine from a young lad on a farm in Kent, who told me that he and his brother had built it because they had been so much interested in the real engine which worked on their own farm. These were poor lads without more pocket money than they could set aside from their scanty earnings as farm labourers, and yet they had, bit by bit, acquired the material, and by very intelligent observation had constructed a baby replica of their daily companion, the farm engine. But even more remarkable was the equipment with which it was built. In a small shed they had set up their own workshop, the high spot of which was a lathe they had themselves contrived mainly from the remnants of an old iron bedstead and a disused bicycle. To crown their success, they brought their engine to *The Model Engineer* Exhibition of that year, and ran it under its own steam. Their ingenuity and pertinacity, in the face of difficulties, was appropriately rewarded by the judges at the show. Yet another remarkable achievement was that of Mr. E. J. Windsor, who built the most complete and realistic model of an engineering workshop I have yet seen. Mr. Windsor, the

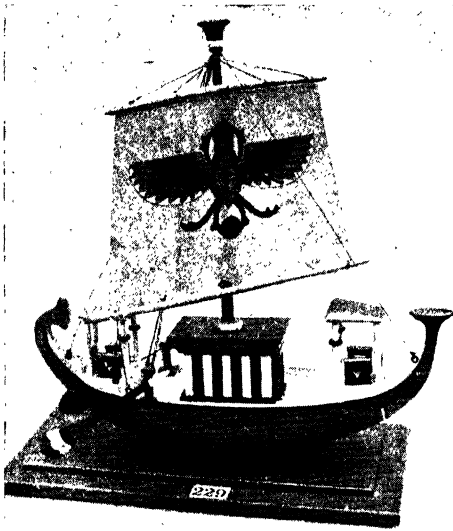
A Remarkable Model Workshop

works-engineer of a spectacle making firm, suffered from a very unfortunate affliction ; he stuttered so badly that he had difficulty in maintaining conversation. Finding that he was unable to share in normal social intercourse without considerable embarrassment, he sought seclusion in a home workshop where he could quietly pursue a hobby at his leisure. He built a model of an engineer's lathe, and then another lathe of a different type. Machine by machine he fashioned the complete equipment of an elaborate engineering workshop, lathes, drilling machines, planing machines, work benches, an overhead crane, and everything which would be found in an up-to-date plant. This also became a star exhibit at *The Model Engineer's* annual show, in 1911, where it attracted the admiration of Lady Maxim, the widow of that famous engineer and inventor, Sir Hiram Maxim. She approached Mr. Windsor to ascertain if he would be willing to part with his model-making masterpiece, and, terms having been arranged, she purchased the model and presented it to the Institution of Mechanical Engineers, in memory of her late husband, who had for many years been a member of the Institution. There the model now occupies an honoured position, and is a constant source of interest to the members and visitors. Mr. Windsor naturally parted with his model, the patient work of many years, with some considerable reluctance, but I think he rightly felt that it would be better placed where it could be seen by engineers who could appreciate its qualities, than it would be in the seclusion of his own home.

Some Distinguished Model Engineers

I have related these little stories to show from what unexpected beginnings the desire to embark on model-making frequently arises. It is, perhaps, not so surprising to find accomplished engineers turning to the convenience of a private experimental workshop as an additional outlet for their inborn mechanical inspirations. Sir James Swinburne, Bart., and the late Col. R. E. Crompton, both Past-Presidents of the Institution of Electrical Engineers, and Mr. Loughnan Pendred, a Past-President of the Institution of Mechanical Engineers, have all found the lathe an agreeable companion for their leisure moments. Mr. Pendred, among other ingenious activities, has in recent years developed some remarkably clever mechanisms for giving life-like movement to miniature figures he uses in the production of films for home projection. The late Mr. G. F. S. Des Vignes, the famous Thames-side builder of the *Hibernia* and other fast launches, was a life-long model engineer, his first model dating from his days as a student in the engineering department of Kings College, London. He modelled engines of all types for his own

Early Model Engineering



The maritime glory of Egypt inspired the building of this beautiful model.]

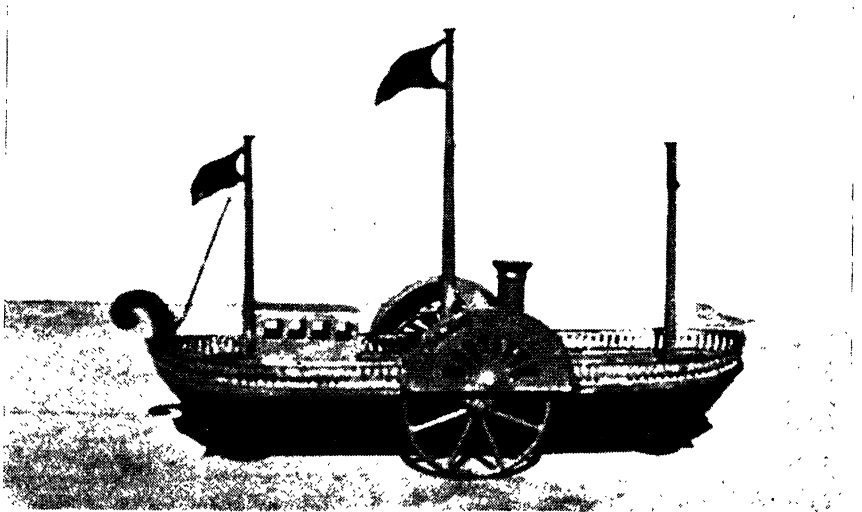
pleasure, and I think this interest kept him young both in mind and body. His only concession to advancing years was when late in his seventies he installed an electric motor to drive his lathe at home, to relieve him from the strenuous work of foot-peddalling. I also remember how Sir Francis Spring, after a distinguished career in railway engineering in India, decided that a home workshop was the best thing he could have to afford him agreeable occupation in his years of retirement at his pleasant home in Jersey. The success of this endeavour is illustrated by the fact that he built himself a Grandfather

clock as his own present for his 81st birthday. Mr. Henry Lea, an eminent consulting engineer in Birmingham, built and equipped a model railway in his garden. This had a novel feature of interest, the running of the steam locomotive on the track could be controlled by electrical mechanism operated from a fixed switchboard at the starting point. Mr. Lea was a very expert mechanic, and his private workshop contained many ingenious tools and gadgets. He was particularly clever in making model steam injectors, which worked admirably. A model injector to a small scale calls for great exactitude in the making and adjustment of its component parts.

Other model engineers have approached their hobby from quite a different point of view. My friend, the late Sir William Smith-Marriott, Bart., of Horsmonden, in Kent, had a remarkably well equipped workshop in which he used to bring into concrete form the inventive ideas of his fertile brain. One such idea, a machine for rapidly winding hanks of knitting wool into balls, proved most successful in operation and brought him numerous requests from knitting parties for such an assistance in their work. He was an early experimenter in the application of motive power to lawn mowers, and also constructed a very successful ram for maintaining the water supply of his house. General Sir George

A Workshop Worth Seeing

Forestier Walker was another model engineer of the utilitarian type. His workshop was put to continuous service in the making and repairing of the many machines and appliances used on his country estate. Still another angle of interest was demonstrated to me by an old neighbour of mine, a Mr. Adams. By way of making my acquaintance he called at my house one evening, and as an excuse for approaching me, he began to discuss a local church bazaar in which he thought I might be interested. Then he stopped and smiled. He said "I really did not want to talk about the bazaar, but I heard that you were the Editor of *The Model Engineer* and I thought I would like you to come over and see my workshop." Of course, I smiled too, and said I would come with pleasure. It was a workshop worth seeing. Occupying one of the best rooms in the house, it was replete with fine lathes, milling and drilling machines, and work benches. Around the walls were elaborate cabinets, the shelves and drawers of which were filled with chucks, milling cutters, screwing tackle, drills, reamers, micrometers, and almost every conceivable kind of small engineering tool. "Now," I said, "show me some of the models you make with all this wonderful equipment." He blushed, and directed my attention to a very simple half-finished vertical steam engine. "That, I must admit" he said, "is all I have to show. The fact is, I do not attempt to do very much model making. I have a passion



A genuine antique—a toy model of an early paddle steamer made over 100 years ago.

Early Model Engineering

for good tools, and my pleasure is to collect them, keep them in good condition, try them out on various jobs, and make some accessories or additional tools to my own liking." The workshop and machines, some of very expensive types, were kept in splendid condition by the loving hand of the owner and had afforded him many agreeable hours of occupation and thought.

The Curative Value of Model Making

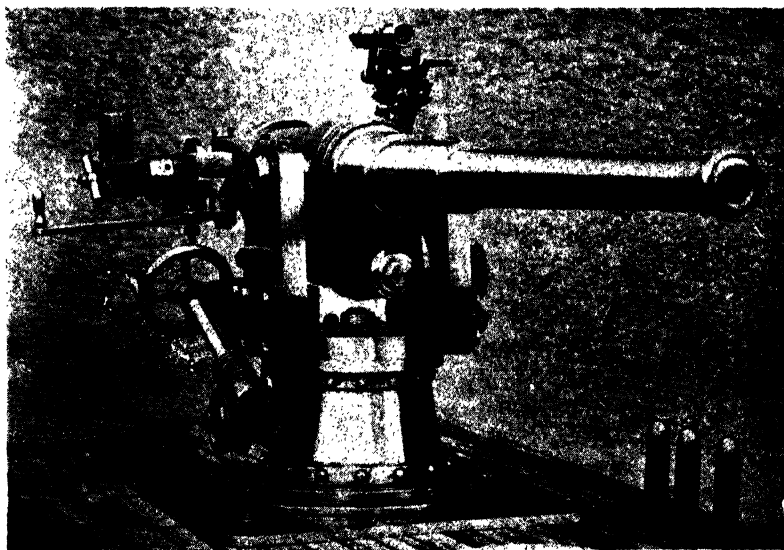
The curative value of a handicraft occupation for those who are temporarily disabled in mind or body is well-known to the medical profession, and model making stands high in the list of suitable light activities. An instance of such a cure comes to my mind as I write. A reader of *The Model Engineer* unfortunately got badly knocked about in a works explosion. Among other injuries, he entirely lost the use of his left hand, and was obliged to spend a long period of convalescence in a hospital. After ten months in bed he was able to sit up in a bath chair and with the aid of a small vice clamped to the arm of the chair, and a few simple tools, he made some of the smaller fittings for a locomotive he was intending to build. At first he could only use his right hand, but when his left hand was released from plaster he began to exercise it very gently on his model making work. In due course the hand began to show signs of life, and he says that today, apart from certain weaknesses, it is almost normal. He wrote to me "Although I have been constructing things more or less all my life, I have only realised the true value of model engineering during the more recent years, and never more so than during the past three. My model engineering efforts while in hospital gave me enormous satisfaction, and set my mind very much more at ease. Truly, I can say, that model engineering has paid me a very handsome dividend indeed, and if I should live to be ninety I feel sure I should still like it as much as I do now." Mr. Puckle, of Maidenhead, is a clever ship modeller, who can only work with his left hand, and I remember the work of Mr. Frost, a pattern maker, whose work, with one hand only, was equal to the best of those more happily blessed with two hands. It seems that no physical disability can defeat those who are determined to overcome their misfortune and build good models.

Models for the Blind

You might imagine that an exhibition of models offered no great attraction to a blind person, yet cases have been known where a blind visitor has, with the guidance of a friend, been able to make a tour of

Models for the Blind

such an exhibition with much interest and enjoyment. By passing his hands lightly over the exhibits, and listening to the explanations of his friend, the visitor has been able to understand and appreciate the character and quality of the models on show. The sensitive touch which seems to be a special gift of blind people has enabled him to appreciate the delicacy and fine finish of the exhibits he was so unfortunately unable to see. In the education of the blind, models are of particular value. Imagine how readily a person blind from birth could, from a model, understand the appearance and the general construction of a locomotive or a ship, or even a much simpler object which his eyes had never seen. He could not very readily pass his hands over a full-sized engine or ship, but by feeling carefully round a model he would get a clear notion of what the real object was like. I do not know of any instances of blind people making models, but it is well known that they can be taught handicrafts and can produce well made and useful articles. Strange as it may seem, I did know a young man, almost completely blind, who was a successful worker on a lathe. He seemed to have the facility of keeping his hands and fingers out of harm's way of the moving machine, and could produce quite creditable examples of turned work.



Model gun-making interests many model engineers. This excellent model of a naval weapon is the work of Mr. S. A. Walter.

Early Model Engineering

Lady Model Makers

Lest it should be thought that the honours of model engineering are monopolised by the sterner sex, I should like to pay tribute to some notable examples of women's work. Miss Bridges, a nurse, some years ago built a large model of a battleship, very complete in all its detail, which she exhibited on numerous occasions in aid of benevolent causes. A doctor's wife, Mrs. P. R. Boswell, has built and exhibited an excellent model of an L.N.E.R. o-6-o locomotive, electrically driven and a faithful replica of its prototype in all essential detail. Mrs. Austen Walton is another successful lady builder of model locomotives. Miss F. Palmer made a farm wagon drawn by a team of life-like model horses. This was so good that at *The Model Engineer* Exhibition it was awarded the special cup, offered by Admiral Sir Reginald Bacon, for the best model made by a lady competitor. Sir Reginald's wife, Lady Bacon, has at times, through her exquisite needlework, done some beautiful sail making for her husband's realistic sailing men-of-war models. Other ladies have exhibited excellent ship models on many occasions. Model engineering in the home is often a family affair, the wife and daughter contributing most effectively to the furnishings of model railway cars, ship saloons and model buildings, and to the making of artistic scenic settings. Several model engineering societies have recently opened their ranks to lady members, and it is no uncommon thing to see a lady engine driver at the throttle of a passenger-hauling locomotive under steam.

The Personal Experience of a Notable Model Engineer

In this chapter I have endeavoured to give some of the reasons which have prompted people to take up model engineering, and to indicate the various interests it affords them. As the book proceeds these interests will become more apparent, and, perhaps, more definite in regard to special lines of activity, but I should like to conclude this introduction with the experience of one whom I have always regarded as the most skilful exponent of the art of model engineering in its true hobby sense I have ever known. I refer to Dr. J. Bradbury Winter, whose acquaintance I was fortunate enough to make at the very inception of *The Model Engineer*. Dr. Winter, most modest of men, would not wish me unduly to sing his praises, so I must leave the beautiful examples of his work, which are illustrated in later pages, to speak for themselves. I cannot refrain, however, from quoting a remark he made to a visitor to his home in Brighton, who was inspecting his model of the locomotive "Como," the engine portion of which had just been completed. The visitor was astonished to learn that this model represented thirteen years

A Notable Model Engineer

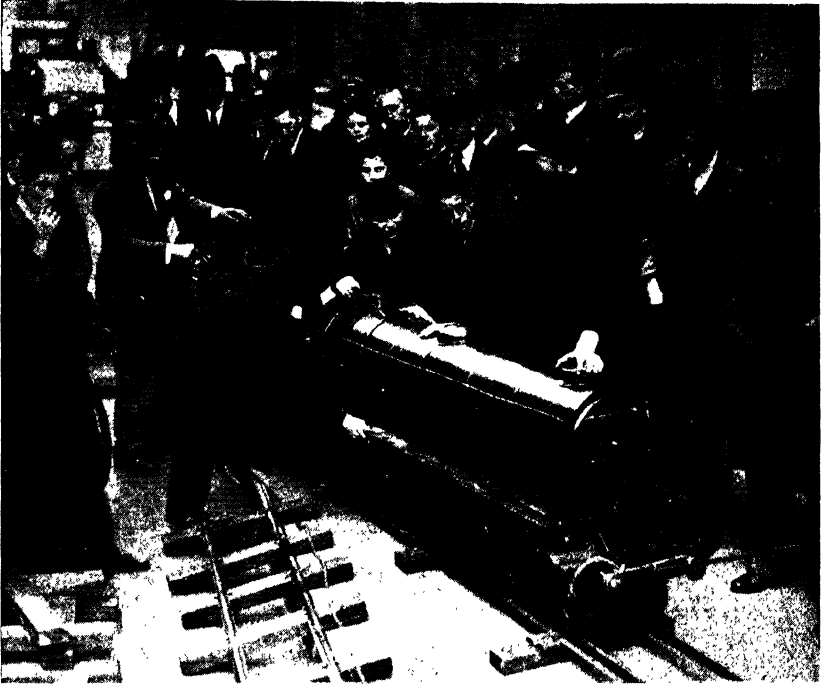


Photo by]

[Fox Photos Ltd.

A good model always draws a crowd. The attraction here is a model of the locomotive "Wendy" being delivered at the Central Hall, for the exhibition of the Model Railway Club.

of spare time work. "Don't you think, Doctor," the visitor asked, "that you could have utilised your spare time to better advantage?" "Not at all," replied Dr. Winter, "It has given me thirteen years of pleasure in the making, and what is perhaps more important, it has afforded me mental and physical recreation, which has enabled me to do my daily professional work with far more efficiency." That goes right to the heart of the value of model engineering as a hobby, and scores of busy workers in all kinds of occupations have given me a comparable opinion over and over again. During the forty years which have elapsed since Dr. Winter made that memorable remark, he has built many ingenious and beautiful models, and I recently asked him if he would be good enough to sum up for me the pleasures and helpful influence of his life-long hobby. I am pleased to be able to give this in his own words. He wrote :—

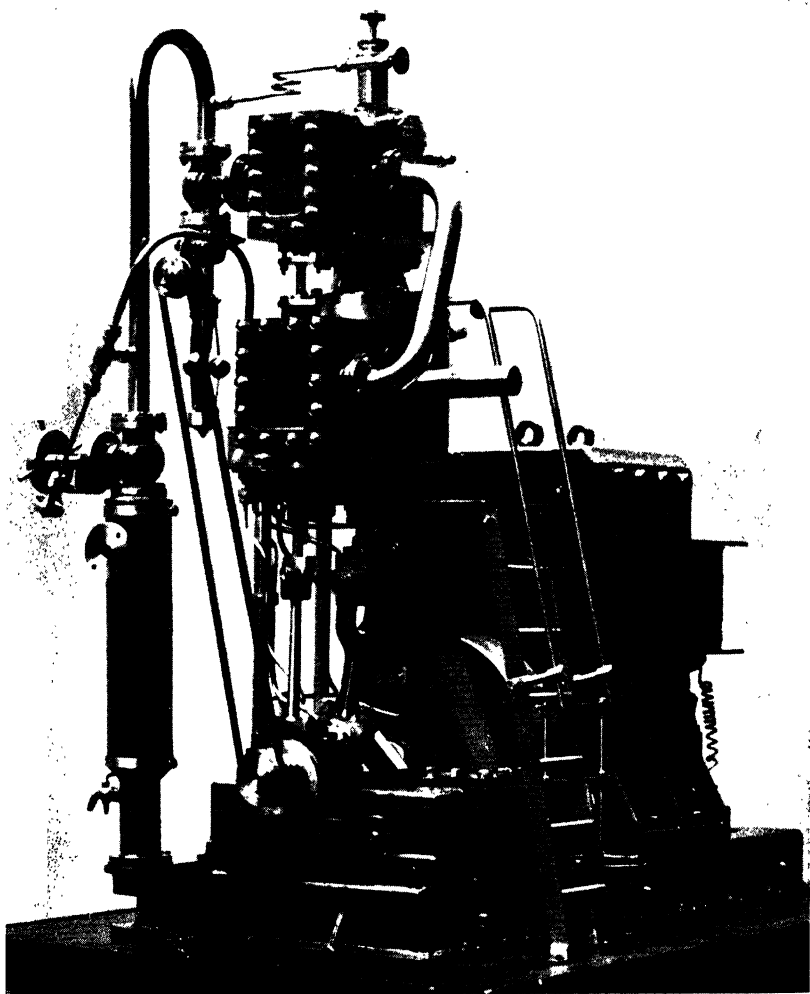
Early Model Engineering

"A well known man once said 'There's no fun like work.' I thoroughly endorse this statement if the work is congenial, in harmony with the worker's temperament. A mechanically-minded man or boy will be happier when working at some object which he has set his heart on making, than when being entertained by any transient pleasure which leaves nothing to show for it in the end.

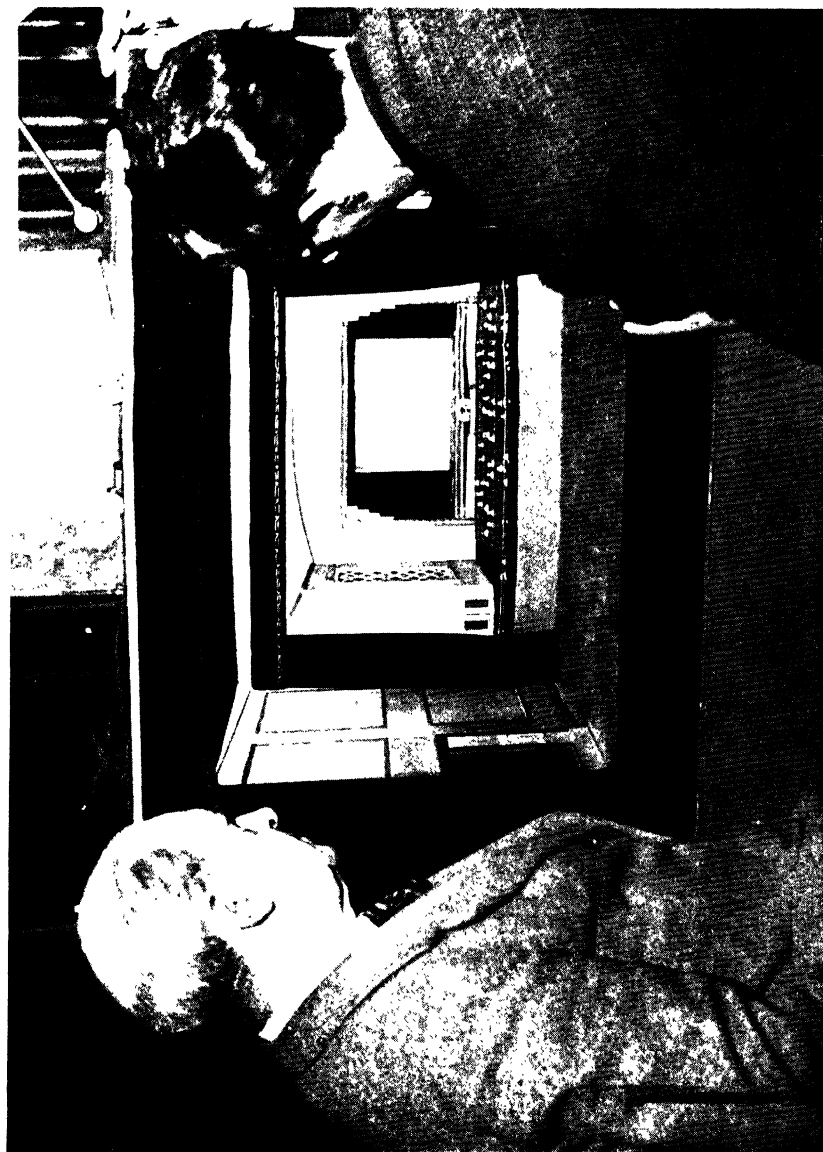
"It is difficult for me to imagine what my life would have been like if I had not been able to indulge in model engineering. Thanks to my father, who from my earliest recollections was always encouraging me to make things, ('carpentering' we called it) and who built a workshop for me at the age of nine, equipped it further with a lathe when I was fourteen, and a 'Pitler' lathe some years later, thanks to him I have never known what it means to be dull or bored. My school holidays were an unbroken joy, almost the whole time spent in my workshop, alone, but never for one moment lonely; absolutely absorbed in whatever I was making.

"The 'fun' of working has persisted without pause all through my life till the infirmities of old age have put a natural end to it. What have I to show for it? Any amount of personal enjoyment, of course. But has my hobby brought pleasure to others? I know that it has. My young son delighted in sitting on a truck behind my inch-to-the-foot locomotive, driving it over a network of lines in our garden. An artist who paints pictures for which people will pay thousands of pounds has certainly given pleasure to others; and so too if I have made a model locomotive which recalls all the beauty and grace and efficiency of Stroudley's masterpieces, so that hundreds of engineers, including a majority of the drivers and mechanics of the Brighton Railway, not only go to look at it, but go over and over again to feast their eyes and revive old memories, I have done something more than just amuse myself. It has been time well spent and worth while.

"But 'model engineering' is too exclusive a term for our hobby. We are not limited to making copies of other men's designs. As much, or greater satisfaction is derived from sitting down to a blank piece of paper on a drawing board, and spending weeks, or months designing some complicated piece of mechanism, entirely original, and then passing on to the next stage, making in the workshop what has been evolved with such concentration of thought on the drawing board. I personally have in this way been led off along this branch of our art, and the results of my work are at the present time giving immense pleasure to those for whom I have designed and made these samples of mechanical ingenuity.



Model direct-coupled Engine and Dynamo. Scale $1\frac{1}{2}$ in. to the foot. Cylinders $1\frac{1}{4}$ and 2-in. bore. Stroke, $1\frac{1}{4}$ in. Built by Mr. Walter T. W. Rolls of Nottingham



THE WORLD'S SMALLEST WORKING MODEL CINEMA
Made by Mr. F. W. Benton left and Mr. R. C. Marshall right of the Malden and District
Society of Model Engineers

A Model Engineer's Experiences

“ I have been speaking of my own personal experiences ; but I must just touch on the amazing growth of our hobby during the last fifty years. As a boy, it was rare for me to find other boys who could share and understand my enthusiasm. Now, there are thousands of model engineers, raked in and brought together, spreading the infection wholesale in clubs and local gatherings, all kept in touch with one another through that extraordinarily successful journal, THE MODEL ENGINEER, which, in forty years, has spread, literally, all over the world.

“ Naturally the trade has been quick to see here a big field for enterprise, and whereas when I was a boy I worked for years without seeing a twist drill ; and hack saws had to be sharpened with a file after ten minutes use on mild steel ; B.A. screws, with their taps and dies were unknown, etc., the trade now caters for every want, and at astonishingly low prices. All this immense growth, both professional and amateur, must be ascribed to the conception of starting a journal which should bring together all the latent enthusiasm which was only awaiting the call.”

I do not think I can better conclude this introductory chapter than with Dr. Winter's very vivid exposition of the virtues of model engineering as a hobby. I will leave the reader to absorb its note of true enthusiasm, and will pass on to some of the more practical aspects of my subject.

II

FIRST ATTEMPTS

With Some Advice to the Beginner

Before I proceed to describe some of the many beautiful achievements of model engineers, I think it would be a good thing to have a talk with the beginner about the materials and equipment used in model making, and the more elementary workshop processes involved. A little knowledge of this kind will not only enable him better to appreciate the quality of the models to be described, but will give him an insight into the requirements of the hobby and will assist him in deciding if it is within reach of his manual skill and his pocket. The expert mechanic may pass over this chapter if he wishes, as he will learn little from it of technical value. It may, however, serve to remind him of his own problems as a beginner, and will, perhaps, encourage him to hold out a helping hand to those who stand hesitatingly on the brink of the hobby.

The Qualifications of a Model Engineer

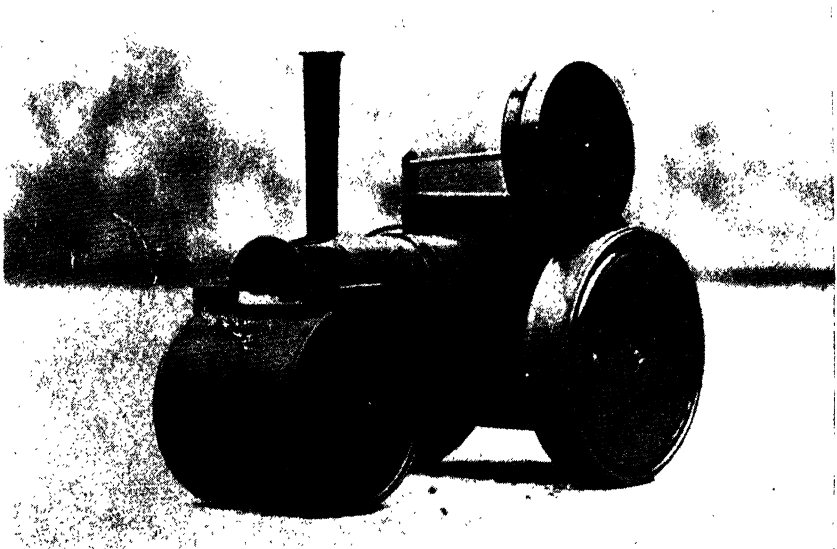
There are two essential personal qualifications for the successful model maker. Firstly patience, and secondly, some small degree of natural ability in the handling of tools. Patience is necessary, for the building of a good model proceeds slowly, and any undue desire to hurry the work and "see the wheels go round" will lead to disappointing results. Some simple, yet effective, models may be made in a few days or weeks, but more elaborate models will occupy the spare time of months or years. The true model maker does not hurry over his work. It is a labour of love for him, and very often when the model is at last completed, he feels he has lost a friend because there is nothing more he can do to it. Ability in tool using may be acquired by practice, and it is surprising how skilful the untaught amateur may become. Everyone knows people whose fingers are all thumbs, and who cannot even use a hammer to drive a nail. They shine, perhaps, in other directions,

Very Simple Model Making

and model engineering may not be the ideal hobby for them. But even they can derive much enjoyment from operating a model railway or sailing a model boat. Given, however, some modest facility in using a hammer, or a saw, or a screwdriver, there is no limit to which this initial aptitude may not be developed.

Very Simple Model Making

No one need be debarred from venturing into model making by the lack of tools and materials. With patience and a pocket knife a great deal may be accomplished. I mean this literally, for some most remarkable models have been built with the very simplest of tools and the commonest of materials. Add to the pocket knife, some pieces of wood or cardboard, some liquid glue or other adhesive, a few assorted paints, a bradawl for making holes, and, perhaps, some pins or odd pieces of wire, and you can conjure up most attractive model buildings, or a miniature model ship, or even a model engine. The engine made of such material will not work by steam, of course, but it will satisfy the eye, especially if suitably painted, and the working parts may even revolve. Look, for example, at the photograph I give of the very simple model steam roller, made from odds and ends of material. It is just a



A very simple model of a steam roller. Built as a toy from odds and ends of material, but having good proportions and a realistic appearance.

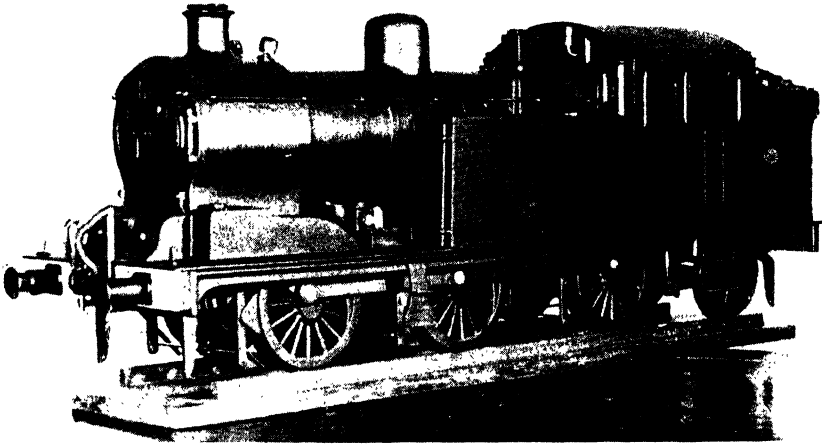
First Attempts

toy but, I think, of pleasing appearance in general outline, and could be very effective if nicely painted. The story of this model is not without interest. A drawing by Mr. W. J. Hughes, was originally published in *The Model Engineer* as a suggestion for a Christmas toy, which might be easily and quickly made from simple materials to be found in any house. Another reader, Mr. P. T. B. Browne, took a fancy to this and got busy in his workshop, with the attractive result shown in the photograph. The only departure from the instructions was that the boiler was made from a piece of a rolling pin instead of from cocoa tins. Here we have a very simple example of model making, within the reach of every beginner, which may yet lead some day to the construction of a complete scale model of a real steam roller or traction engine. "Big oak trees from little acorns grow."

Locomotive Modelling in Wood

Something of a much more elaborate nature, but still showing what pleasing results can be achieved with the simplest of tools and materials, is illustrated in the photograph of the model locomotive in wood, made by Mr. W. E. Downes, who is a train controller on the L.N.E.R. It is a remarkably realistic piece of work and a triumph of patience. Mr. Downes has kindly furnished some notes on the construction of this model which I am sure will be read with interest. He says :—

"The model here described is representative of an L.N.E.R. (G.E. Section) 0-6-2 tank locomotive, and is built almost entirely of wood to a scale of one inch to the foot. There is no motive power of any description, as the intention was to build a 'showcase' model of this particular type of locomotive as near to scale and as closely resembling the prototype as possible. Plans for the model were drawn up and the work commenced in 1937. The outbreak of hostilities in 1939 found the locomotive finished with the exception of the lining out and lettering which has still to be completed in consequence of lack of time and materials. Plywood is used mainly in its construction and every part was made by hand with the aid of the simple tools to be found in nearly every household in the country. The model is 36 in. long, 12 in. high, and 9 in. wide, and consists of about 200 separate pieces. In a model of this scale a wealth of detail must be incorporated, and the host of items involved meant many months of careful and tedious work on such components as handrail knobs, lamp brackets, etc., which all had to be filed to size and shape by hand, and which were almost too small to manipulate. The wheels presented the greatest difficulty, as these were built up, the rim, centre



An excellent scale model of a L.N.E.R. locomotive, built almost entirely of wood, by Mr. W. E. Downes. Scale 1 in. to the foot.

boss and spokes all being made and fitted independently. In the case of the driving and coupled wheels, 24 separate pieces went to the making of each. Much careful thought and planning were necessary before ever an attempt was made on the model. The particular type chosen lent itself admirably to reproduction in wood which many other types would not do, but much experiment was necessary before embarking on the actual work."

This is the fifth model Mr. Downes has built and so far, is the largest he has undertaken. He considers that the most interesting and fascinating phase of the whole work is in the final painting and finishing, which calls for great care and skill, if the patient work of many months is not to be ruined. The model here described has received about a dozen coats of paint, but like its hard-worked brothers, has at the time of writing, remained in its wartime garb. Your first attempt at model making may not be as ambitious as this, but here is an ideal to aim at if you are locomotive-minded and your resources are restricted.

Suggestions for Simple Model Making

For inspiration of another kind, turn to the chapter on model railways, and look at the remarkably realistic modelling of lineside buildings, by Mr. J. H. Ahern. Or yet again, look round your own home and

First Attempts

choose a table or a chair which would look well in miniature. Get out your pocket knife and a piece of wood and carve the bits and pieces which, when assembled, will give you a tiny replica of a favourite piece of furniture. Perhaps your thoughts turn to ships instead of tables and chairs ; if so, your pocket knife will be the main equipment in enabling you to fashion a charming miniature waterline model of the *Queen Mary*, or some other famous ship, or a beautiful yacht. This is all very elementary and may not seem like model engineering, but little experiments of this kind are the seeds from which more elaborate flowers will grow, and will convince you of the absorbing and mentally restful nature of the hobby. Remember the story told in Chapter I of the remarkable little shops, which grew from the unconsciously formed miniature wax tomato. If miniature ship modelling be your choice, it has the merit of necessitating very little accommodation by way of a workshop. I knew a retired naval captain who made some exquisite miniature models of old-time sailing ships. His workshop consisted of a tray containing his small tools and his bits and pieces of material. After dinner he would have his tray brought alongside his arm chair, and would happily proceed with the carving and rigging of his models by the fireside. Another enthusiast of my acquaintance was a London taxi-driver, who made many of the details of his ship models while sitting on his cab on the rank waiting for fares. He was a genuine student of naval architecture and nautical history, and on his off days would frequent the Science Museum, at South Kensington, to add to his knowledge of historical detail in ship construction.

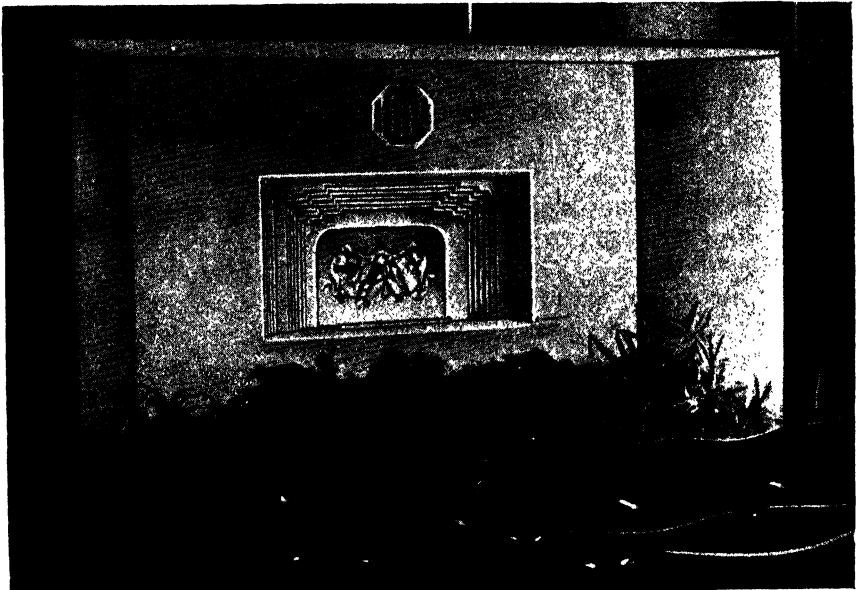
A comparatively simple, but very effective, kind of work is the modelling of various types of aircraft in the solid. That is to say, models which contain no working parts, and are not intended to fly, but represent, on a miniature scale, some of the famous aeroplanes which have made history either in the war or in civil aviation. These models can be made to any size, an inch or two in wing span, or as much larger as the fancy of the builder may dictate. When appropriately coloured they make very pretty and decorative models, and the materials and tools required are of the simplest character.

A Remarkable Model Theatre

The model theatre offers yet another outlet for experiment with simple workshop equipment. The construction of the stage and scenery, mechanical effects, electric lighting, the "props" as they are termed professionally, all afford endless scope for neat craftsmanship and artistic ability. Model theatres have been a family hobby at the Worcestershire

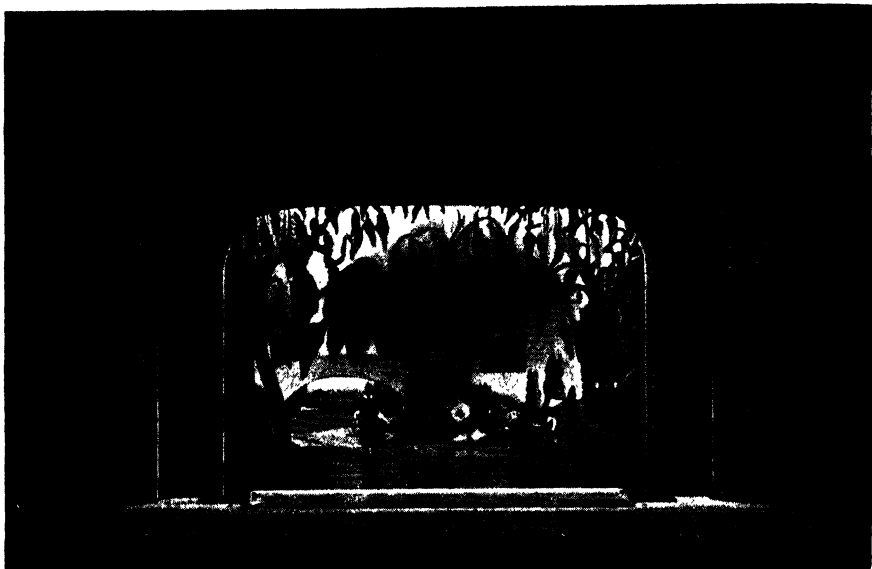
A Model Theatre

home of Mr. Cecil C. Brinton for three generations. Modern science has been applied to their productions in a most entertaining way. The characters are moved about on the stage by electro-magnets on pivoted arms underneath, the various coloured and spot lighting effects are all electric, and most ingenious mechanical contrivances provide for the surprises called for by the action of the play. In a performance of Weber's "Der Freischütz," which I was privileged to witness, we were shown the wonderful shooting by the hero with the aid of magic bullets, the midnight casting of these bullets by the devil in a fiery furnace in the mountains, and the ride of the devil's attendant satellites over the mountain tops. All these effects gave as much pleasure in their planning and construction, as they did to the delighted audience. Theatrical managers and producers frequently use model stage settings to explore the possibilities of scenic arrangement and lighting before starting on a full-size layout. If a stage performance does not attract you, there may be inspiration in modelling a complete theatre, a cinema, a doll's house, or even a Noah's Ark.



The proscenium of a model theatre, built by Mr. Cecil C. Brinton and family, known as the Heatherington Theatre Royal, Belbroughton.

First Attempts



Scenic setting for the play "Once on a Time" on the model stage of the Heatherington Theatre Royal.

Use Your Hands

I make these suggestions because tastes and inclinations vary so very much, and I do want to persuade my reader to make a beginning in some direction and enjoy the pleasures of creative effort by using his hands. Success may not come all at once. There will be failures, perhaps, and misfits, but the fascination of the work will grow, and improving skill will lead to the achievement of bigger and better things. Choose something simple to begin with, work patiently at it, and you will succeed. The joy of seeing the child of your hands grow to completion must be experienced to be appreciated. It is very real and every model engineer has discovered it.

Tools and Materials

So far I have referred to types of models requiring only very simple tools and materials. I think everybody knows something about tools for woodworking and their uses. Wood is an easy material to work ; the carpenter is a familiar friend, and most of us have watched him sawing or planing, or paring wood with a chisel. The household tool-box usually contains several of the tools required, and any additional items are readily obtainable as and when required from the local ironmonger

or tool dealer. Although wood-working tools are simple in character there is a right and a wrong way of using them. Even the homely bradawl is frequently incorrectly applied. It has a flat cutting edge and this should be inserted *across* the grain of the wood, and not in line with it. If the latter position is adopted on a thin piece of wood, the result will be a crack or a split as the tool is forced in, whereas when applied across the grain the tool cuts its way through. All woodworking tools, even the pocket knife, depend for their efficiency on being kept sharp. Blunt tools merely tear the material and leave rough and inaccurate surfaces.

When we come to the cutting and shaping of metal we enter upon what may be strange ground to the beginner, and he wonders how this mysterious work is accomplished. As a matter of fact, the working of metal is really no more difficult than the working of wood, but since metal is so much harder, cutting proceeds more slowly, and different types of tools are required. It is not my purpose here to give detailed instruction in metal working since that ground is already well covered in other handbooks, but I think a little general talk about the metals and tools usually employed in model engineering may be of interest.

Some Facts About Metals

So far as the metals themselves are concerned, the principal materials are iron, steel, brass, gunmetal, copper and aluminium. Iron may be of two kinds, cast iron and wrought iron. Cast iron is a hard close-grained metal used for such parts as cylinders, fly-wheels, pulleys, frames, and bed-plates. It is so called because it is the result of casting or pouring molten iron into moulds of the shape of the required article. When a casting for a part of an engine or machine is needed, a wooden pattern of the required article is made, and this is embedded in a special kind of sand, contained in an iron moulding box. The sand is rammed tightly round the pattern, and when the latter is removed the impression left in the sand is the mould into which the melted iron is poured. The same process is followed when castings in brass, or gunmetal, or other metals are required. The beginner need not worry himself about the difficulties of making castings, for there are trade firms from whom he can obtain ready made, most of the castings he is likely to require. If he should wish for a casting to a special size or shape, he can make his own wooden pattern and get the actual casting made for him at a foundry. There is a particular thrill when working on a casting, in the thought that one is repeating in miniature one of the processes of the real engineering workshop. A casting has quite a professional air about it.

First Attempts

Wrought iron is a tough fibrous material sold in bars, or rods, or sheets which may be readily bent or worked into various shapes when heated, or, to some extent, when cold. It is not largely used in model making, its place usually being taken by mild steel. This is iron containing a certain percentage of carbon ; it is tough and fibrous in character, and is harder and stronger than wrought iron. It has a closer grain, and is capable of being readily turned and machined, and takes a high degree of polish. It is largely used for such details as piston rods, connecting rods, pillars, screws, pins, bolts and nuts, and many small parts of models where strength and ease of working are required. Cast steel is a still harder material, having varying chemical ingredients in small quantities, which give it its peculiar qualities. It is capable of being hardened and tempered and for this reason is largely used for lathe tools, cutters, files, drills, and other metal working tools where tempering to a strong but keen cutting edge is required.

Brass is not a pure metal, but an alloy, that is a metal composed of two or more pure metals mixed together. Brass is a very common metal, and varies greatly in its quality, according to the proportions of the metals of which it is constituted. It is an alloy of copper and zinc, and it varies in colour and strength according to the proportion of the zinc element. A comparatively soft metal, easy to work and taking a high polish, it is much used in model making, particularly for parts not subjected to continuous wear or having to withstand pressure. It is very suitable for tanks containing liquid, locomotive tenders, and similar purposes. Cylinders, steam fittings, and other parts which are subjected to regular wear and tear are usually made of gunmetal. This is a composition of copper and tin, with a small proportion of zinc. It is a close-grained metal, darker in colour and much harder than brass, and has many uses in model engine building. Though harder, it is easy to machine, and also takes a high degree of finish.

Copper is a most useful metal for the model engineer. It is the ideal material for locomotive, traction engine, and other steam boilers, and pipes for steam, lubricating oil, and water supply. Real locomotive boilers are made mainly of steel, but for working models the proportionately thinner metal used would be very subject to the effects of corrosion. Copper is an easier metal to work and free from corrosive action, and except for models built to a fairly large scale, it is universally adopted. Copper is obtainable in sheets and tubes of all thicknesses, and for the barrels of locomotive boilers "solid-drawn" copper tube of a suitable diameter is ideal. For very small boilers, working at comparatively low pressures, sheet brass may be used with safety,



A model of a motor omnibus made by Mr. Albert Morley, of Stanmore. It is $38\frac{1}{2}$ in. long, $22\frac{1}{2}$ in. high, and $12\frac{1}{2}$ in. wide. It took ten months of spare time to make.

but for the higher pressure ranges copper is much to be preferred.

Aluminium is a metal which is of much service to model engineers in carrying out designs where lightness is important. In its pure state it does not possess great strength or durability, but when alloyed with certain other elements it attains considerable toughness and strength without losing much of its virtue of lightness, and is used in model petrol engines and in many kinds of experimental work. Aluminium alloys are sold under various special names, of which "magnalium" and "duralumin" are examples.

Using the Correct Materials

A word of advice about the choice of metals and materials for model making may not be amiss. A good model should represent its prototype in appearance as closely as possible. That word "prototype" appears frequently in this book, so I may perhaps explain to the uninitiated that it means the original engine or ship or machine of which the model

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is a representation in miniature. The beginner is often tempted to make his model engine all in brass, instead of iron and steel, because it is so much easier to work, and to his eye, it looks so beautifully polished and showy. The true engineer looks upon such a model with something approaching scorn. It is not a real engine to his way of thinking, and fails to arouse the appreciation which he would give to the correctly made model. True-to-life materials should, therefore, be used as far as possible. Where a substitute is used, its identity should be concealed by suitable painting or other discreet camouflage. There are exceptions to every rule, however, and in certain instances beautiful models have been made in substitute materials, which have avowedly been used with a definite purpose in view. The imposing model locomotive in wood, which I have already described is a case in point, and when the painting of this model has been finally completed I imagine it will require a very close inspection to discover its unorthodox material of construction. It will, in any event, satisfy the critical eye of the locomotive expert, whereas if it had been made wholly in polished brass it would have aroused some doubtful comment. Other exceptions to this rule are to be found in model aeroplanes and certain ship models which have been definitely made for decorative purposes. The wonderful "Silver Rocket" locomotive, made by Dr. Bradbury Winter, and illustrated on the frontispiece of this book, is in a class by itself. It was originally intended to be a presentation model to an engineering institution, and it was thought that silver would be an appropriate material to use.

How Metals are Cut

A beginner may well ask how are metals cut into various shapes and sizes? Naturally, his pocket knife, so useful on wood, will make no impression. There are several methods and tools in use—saws, chisels, files, drills, and the lathe and other machine tools. Woodworking tools are of no use for cutting metal, their edges are too keen and too fragile. The principal metal-cutting saw is the hack-saw, a narrow blade held in a hand-frame, which will readily cut through any metal which has not been specially hardened. Smaller saws, like fret-saws, with the teeth specially shaped and tempered, are also used for light work. It must be remembered that in cutting metal the work proceeds more slowly than in cutting wood and slow steady strokes of the saw or file are required. The engineer's chisel is a very different tool from that of the carpenter. It is an all-metal tool, with the flat cutting edge ground to a less acute angle. It is used with a hammer, and is very serviceable for cutting out shapes from sheet metal, and for removing surplus

metal from castings and other pieces of iron, steel, or brass. Most people are familiar with files and their uses. Files are made in many shapes and sizes, and of varying degrees of roughness. There are flat files, round files, half-round files, and three-cornered files, as well as other special shapes. In roughness there are three principal degrees, rough, second-cut, and smooth. The beginner should acquire a small assortment of moderate sized files to start with, and add to their number as his requirements extend.

Holes in metal are made by means of drills. These may be of the diamond-pointed variety for very small holes, and of the twist-drill type for larger holes, although twist drills are made and used down to the thickness of a hair. Much of the drilling required in model making may be done with a hand-brace, in which the drill is held in a chuck and rotated through a hand-drive. This differs in design from the familiar carpenter's brace, which is used with bits of a very different nature. A more general method of drilling is by the use of a drilling machine, of which there are many varieties on the market. I mention this because it is so frequently met with in every kind of workshop, but it is by no means one of the essentials which the beginner requires. What is known as a "sensitive" drill is a very useful tool in the model making workshop. It derives its title of "sensitive" from the fact that pressure is applied to the drill by a hand-lever so that it may be easily regulated according to the progress the drill is making in its work. This is of advantage when using fine drills which may readily be broken if too much pressure is applied. Drilling machines for heavier work are fitted with a hand-wheel and screw feeding motion. Much of the drilling required in model work may also be done in the lathe.

Flat surfaces on metal may be produced by shaping or planing machines or by filing. In the former machine, the tool is moved along the work by means of a sliding ram, operated by hand or power, while in the latter, the tool is stationary and the work, mounted on a sliding table, moves to and fro. These machines are mainly used for surfaces too large to be readily smoothed with a file, and though of service in a fully-equipped workshop, are not really a necessity for most model making. Another method of producing flat or curved surfaces is by the process of "milling." This may be performed in the lathe, or in a separate milling machine. Circular cutters are employed, having a number of sharpened teeth, each of which removes a small fragment of metal as it comes into contact with the material to which it is applied.

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Screws for Model Making

Screws of various sizes are largely used in model making. They are quite different in their threads from the familiar wood screw. In wood-work the screw cuts its own way into the soft material, whereas, in metal-work, the hole to receive the screw has to be threaded to correspond exactly with the thread on the screw. External screw threads, that is the thread on a rod or bolt, are cut by means of "stocks and dies," or may be produced in a screw-cutting lathe. The "die" may be likened to a hardened steel nut, split into halves, and contained in a frame or holder called the "stock." The die is threaded, and the threads are formed with cutting edges. The rod to be screwed is gripped between the halves of the die, and as the stock is turned forwards and backwards, the desired thread is gradually cut. A much simpler and quicker method for the small sizes used in model making is to employ a die which cuts the thread in one operation. Dies of this type are quite cheap and obtainable from all tool shops. Internal threads, or threads in holes, are usually produced by the process of "tapping." A tap is a threaded piece of steel hardened and tempered, having grooves along its length which form cutting edges to the thread. When gradually screwed into the hole, by means of a "tap-wrench," it cuts the thread desired. It is important to note that the hole to be threaded must be drilled smaller than the screw it is intended to receive. It should, in fact, correspond to the diameter of the screw at the bottom of the thread. This is known as the "tapping-size," and there is a correct tapping size for every size of screw. A tap should never be forced into its hole, or a breakage may occur. It should be fed in gradually. Both taps and dies need lubricating with a spot of oil when cutting. The fineness or coarseness of a screw thread depends very largely on the diameter of the bolt or rod on which it is cut. There are standard sizes of threads for different diameters of work. The principal standards in use are the Whitworth thread for the larger sizes, and the British Association, or "B.A." thread for the smaller sizes. There are also special threads for gas fittings and cycle fittings, while for model steam fittings the model engineering standard of 40 threads per inch of length is much used. Bolts and nuts and screws for model making are readily available from trade firms, and every tool dealer can supply the stocks and dies, and taps required for all sizes.

Miscellaneous Tools

A soldering outfit is a necessity in every home workshop. The process of soldering is very simple, and is described in many handbooks. Brazing

Measuring and Marking Out

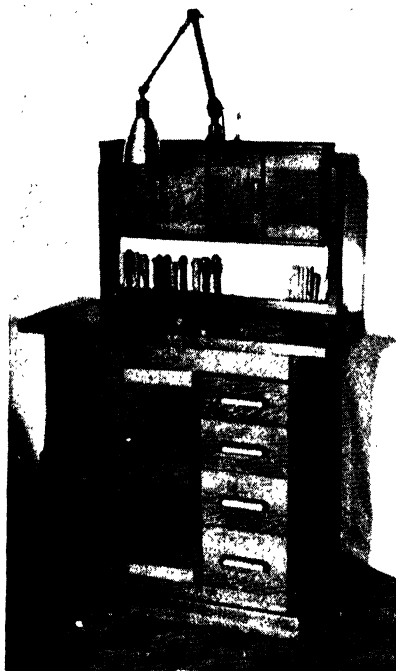
is a somewhat more elaborate method for making joints in boilers and other places where the joint has to withstand both high pressure and heat. The jointing material is spelter, and it is run into place by means of a gas blow-pipe and a special "flux." Here again the perusal of a handbook on the subject is recommended. Tools will not cut unless their edges are kept in good condition, and the workshop must, therefore, contain an oilstone and a grinding wheel of some kind. Small tools can be sharpened very readily on an oilstone of the kind used for wood-working tools, but chisels, drills, and lathe tools need a grindstone or an emery wheel to bring their cutting edges to good shape. When grinding tools on an emery wheel, pressure should only be applied gradually and by easy stages, or the point of the tool will become overheated and its temper spoiled.

Measuring and Marking Out

Something should now be said about making measurements in metal working. Sizes and fits in metal work are of a much more exact order than for woodwork, and the carpenter's two-foot wooden rule is not fine enough in its divisions for the engineer. An engineer's steel rule is required, accurately divided into inches and fractions of an inch. The progress in reducing a piece of metal to a particular size is checked by a pair of calipers, one pattern being made with curved legs for measuring outside sizes, and another with straight legs for measuring the inside diameter of holes. Steel-pointed compasses are used for marking out work, and a sharp-pointed "scriber" is necessary for ruling lines on metal. A centre punch, used with a hammer, makes an indentation in the work to hold the point of a drill steady at the start. A steel square is also required for checking surfaces which have to be finished at right-angles to one another. The micrometer is a device for making extremely accurate workshop measurements, but the model maker may well defer the use of this instrument till his skill with tools is more advanced.

The Vice Bench

An essential item of equipment for metal working is a vice firmly fixed on a bench or table. The carpenter's vice with wooden jaws is not suitable for holding small metal articles. There are many patterns of metal working vices on the market, varying in size from the heavy vice used in real engineering workshops down to the very small vices used by jewellers and watchmakers. A comparatively small vice will answer most of the requirements of the model engineer, and a choice should



A workshop cabinet by Mr. James Topping—"just like a piece of furniture."

not be difficult to make. The workbench on which the vice is fixed should be substantial in character and free from shake or undue movement while work is being done. Vices are also made for use in the hand. These are very convenient for holding small pins and "bits and pieces" which have to be held in one hand while a file or tool of some kind is applied by the other.

The Lathe—the "King of Tools"

I have left to the last any description of the lathe, which has so often been deservedly honoured by the title of "the king of tools." A great deal of model making can be done without a lathe, and the reader need not be discouraged if, for any reason, a lathe is not within his immediate reach. It does, however, obviate much rather tedious hand work and for elaborate engine or machine construction it may be regarded as indispensable. More-

over, it is a fascinating possession and provides endless opportunity for interesting and enjoyable work. Think, too, of the excitement of your friends when they visit your workshop and exclaim: "Why, you have got a lath!" Having gently explained to them that it is pronounced "laythe," you can proceed to demonstrate some of the hundred and one jobs a lathe can do, and they will be enthralled.

There are many types of lathes available to the model-maker, at various prices and of varying degrees of elaboration. Stated very simply, the purpose of a lathe is to enable a piece of material to be revolved while a cutting tool is applied to its surface and so reduce it to a circular form. The travelling Indian or Oriental carpenter uses the simplest lathe in the world. He drives a couple of pegs in the ground an appropriate distance apart. These pegs each carry a projecting nail or steel point, which serve as the lathe centres. He mounts his piece of wood between these centres, twists the cord of a bow around one end of the wood,

A Wardrobe Workshop

and by manipulating the bow causes the work to revolve rapidly to and fro. With a chisel or gouge held in the other hand, or, perhaps, between his toes, he shapes the wood into the desired table leg, or handle, or other object he has been ordered to produce. The simplest form of workshop lathe is not much more than an elaboration of this very elementary outfit. It possesses a bed on which there are two headstocks carrying the centres, and between these the work is supported. On one headstock there is a pulley with a driving belt from a treadle or from a revolving shaft. There is a tool-rest on which the cutting tool is supported, and the tool, held in the hands, is applied to the work as the shaping requires. With a simple lathe of this kind much interesting wood turning can be done,

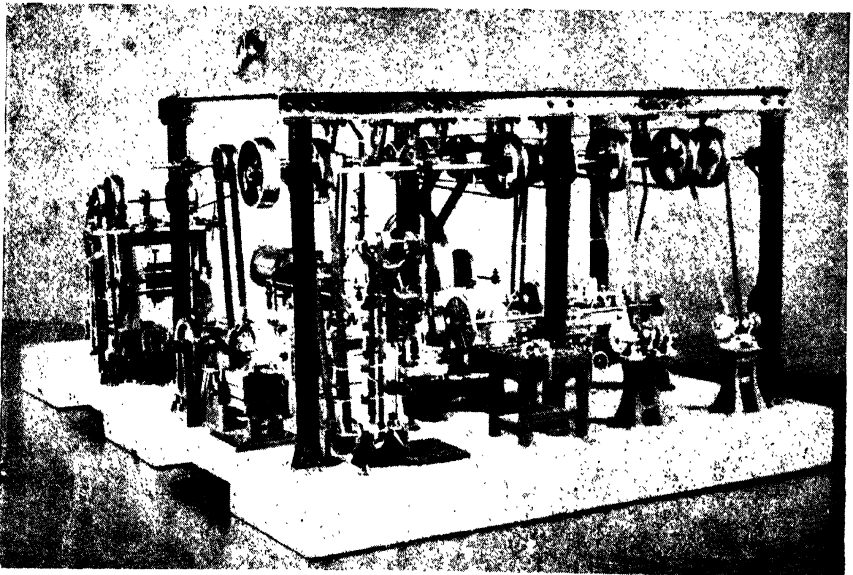


A wardrobe workshop by Mr. A. T. Dewar. Note the lathe with its motor drive and countershaft below.

First Attempts

as well as the fashioning of small fittings in metal for ship modelling, instrument making, and simple model engine work. The first elaboration is the addition of a chuck, a device for holding pieces of material which cannot conveniently be mounted between centres. Then comes a slide-rest. This is a fitting for holding the turning tool firmly in a movable slide, instead of in the hands, thereby greatly facilitating the taking of heavier cuts and producing more accurate work. Next there is "back-gear," which adds gear wheels to the headstock, arranged in such a way that the speed of revolution of the work can be greatly reduced when required. This enables work of larger diameter to be dealt with, and also makes it much easier to turn castings and other rough material where a slow speed is essential in making the preliminary cuts.

Many lathes are still further elaborated by the addition of self-acting and screw-cutting gear. This involves the mounting of the slide-rest on a movable saddle which can slide to-and-fro along the lathe bed. The saddle is capable of being connected to a lead-screw which runs along the whole length of the bed. At one end the lead-screw is connected to the revolving mandrel in the headstock through a train of toothed wheels. When these wheels are brought into gear, and the saddle is connected with the lead-screw, the tool in the slide-rest travels automatically along



A model of an engineer's workshop fitted with a variety of machine tools, and an engine for driving. Made by Mr. J. Adrian Hands.

A Comfortable Home Workshop



The well-fitted and comfortable home workshop belonging to Mr. J. Adrian Hands, Town Clerk of Dorchester.

the surface of the work being turned. This is termed "self-acting." By varying the gear-wheels which drive the lead-screw, the rate of travel of the tool may be varied so as to cut a screw-thread on the work. It is very convenient to have this self-acting motion, as it ensures the tool travelling at an even pace along the work, and relieves the operator from the continual turning of the slide-rest handle. To be able to cut screws in the lathe is also a great advantage on many occasions. There are further additions which can be made to a lathe to increase its service as a general-utility machine-tool. These include milling, dividing, and drilling attachments, and special chucks and fitments, all of which may quite well be left out of consideration in the early days of workshop equipment. As the model engineer acquires knowledge and skill he will be able to decide what accessories he requires, and he may even be able to set about making some of them for himself. He must, however, remember that when buying a lathe, he will need certain extras in the way of chucks, tools, a treadle or other motive power, and perhaps,

First Attempts

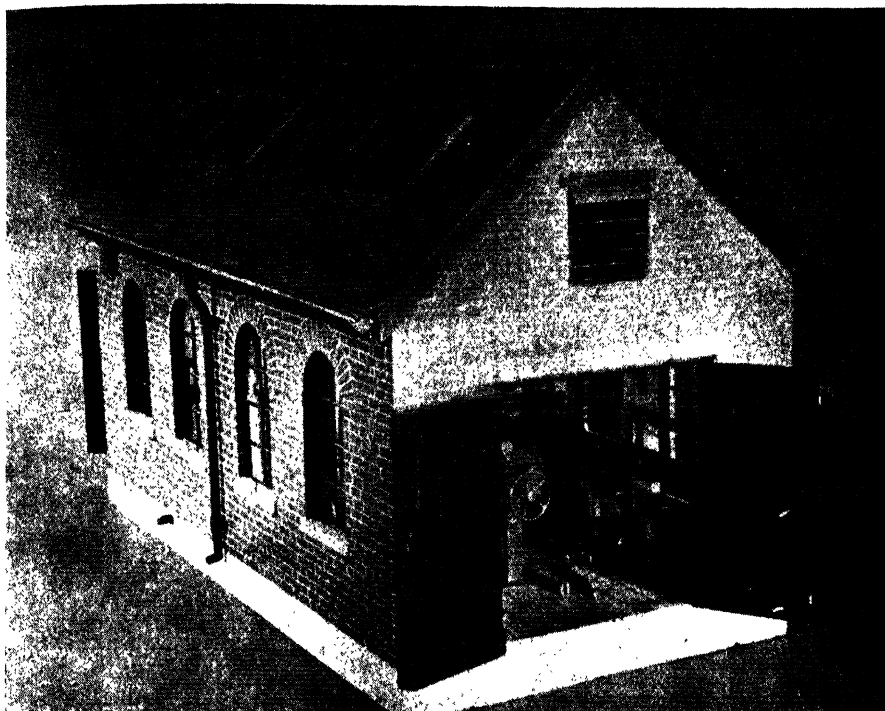
a bench or stand, before he can actually begin to do any work. The cost of these must be added to the cost of the lathe itself. When choosing a lathe, the prospective model engineer must be largely guided by the nature of the work he proposes to do. Money spent in buying a really good lathe is a wise investment, but it does not follow that an elaborate tool will immediately enable the beginner to produce first-class work. Turning is an art which will be acquired by experience, and much useful practice may be gained by first mastering the capabilities of a modest kind of lathe for wood-turning and the simpler kinds of metal work.

I have given these brief notes about workshop tools, because I imagine that the intending model maker will need some preliminary enlightenment on the equipment he will require to make a beginning in the hobby. I picture him browsing over a tool-dealer's catalogue and wondering what this or that tool is used for, and whether it will be necessary to acquire it. He will, perhaps, be confused, and even dismayed, by the multitude and variety of tools offered for his choice, but he may console himself by the thought that he needs only a small selection to begin with, and that his later wants will be amply catered for. I would advise him to purchase his tools gradually as he finds the need for them. It is a mistake to buy too many tools at once, some of which may never, or only very seldom, be required.

The Workshop

Now for a word about the workshop itself. It is naturally of advantage to the hobbyist to have his own "den" where he can make as much noise and litter as he chooses, but everybody is not blessed in this way. I knew a commercial traveller who carried his tool-kit around with him in a suitcase, and did his model making in the evenings in his hotel bedroom. Many very successful models at *The Model Engineer* Exhibition have similarly been built in a bedroom, or on the corner of a kitchen or dining room table. It is astonishing how determination to succeed will overcome the most restrictive of difficulties. Where there is a will, there is a way, we are often told, and the hobby of model engineering is full of praiseworthy examples. I know of a very fine model locomotive built in the dining room of a small flat, and successfully run under steam on a short track laid down in the hallway of the apartment. Some model engineers have devised cabinet workshops on the lines of a book-case or a roll-top desk. They could sit quietly at their work in a sitting room, and when their labours of the evening were ended, they could close their workshop up, in the knowledge that everything was in its place, and free from interference.

A Model Carpenter's Workshop



A demonstration model of a carpenter's power workshop and machine room, built for the Dorchester Town Council by Mr. J. Adrian Hands.

The ideal workshop is a well-lighted and reasonably spacious room indoors, which is kept solely for workshop purposes, and is dry and warm. An attic or upstairs room is generally preferable to a room downstairs, particularly as the rest of the family is not likely to be disturbed by any noise or vibration. Model engineering is not a noisy hobby, but there will be occasional moments when the sound of a hammer or a saw may be heard. Failing a room indoors, a garden shed or portable building or garage, will suffice, if it is really weatherproof. There are many garden workshops in the world of model engineering, and some very fine work issues from them.

The efficient lighting of a workshop is very important. If a good window is available, the lathe should be given the place of honour, but the workbench, and particularly the vice portion, should also be well lighted. No workshop is complete without shelves, tool cupboards and tool racks, and the beginner may well devote his early days to setting

First Attempts

up some accommodation of this kind. Small boxes are very useful for storing small tools and parts, and small glass jars with lids or covers may be especially recommended, as their contents are readily visible.

A First Workshop Equipment

After this review of the future possibilities of a complete workshop, I will close the chapter with a list of the absolute necessities required by a beginner who wants to do metal work. Let him start by acquiring these, and gradually add to them as he becomes more skilled and more ambitious in the kind of work he wishes to undertake.

(1) Bench : Either the real thing, or failing this, a corner of a good solid table.

(2) Vice : With three-inch or four-inch jaws ; parallel action ; to be fixed to the bench, with a window on the far side (the light should be in front of the worker). Or, if no bench is available, the vice may be screwed to a suitable length of board which can be quickly attached to



The well-equipped private workshop of Mr. A. W. Brett, showing a milling machine (left), and a screw-cutting lathe (right) in the foreground.

A Beginner's Tool Outfit

the table with a couple of screw clamps. The board serves as a bench, and saves the table from damage.

(3) Hammers : Two are required, a light one for riveting, and a heavier one for flattening sheet metal, etc. These should be of the engineers' pattern, with a small ball-shaped projection at the back of the head. The carpenter's type of hammer is not so suitable for metal working.

(4) Something flat and heavy on which to place the metal to be hammered. An old flat-iron makes a good anvil. A block of lead is also most useful ; it can be cast in a wooden box of any shape. As a rough guide, a casting three inches square by an inch and a half thick would do admirably, and will be in constant use ; for example, it will be found that if the sheet metal or small items are laid on the bench for centre-popping, the result will be very poor, but if laid on the block of lead it will be totally different.

(5) Scriber.

(6) Centre punch.

(7) Screwdrivers : Two are required, medium and small ; indefinite and vague terms, to be interpreted to suit the owner.

(8) Pliers : Two pairs ; (A) gas pliers ; (B) bell pliers with wire cutter on the side.

(9) Hack saw frame and twelve blades about ten inches long, with fine teeth.

(10) Files : Two flat parallel-sided files with one safe edge (a rough ten inch and a smooth eight inch). Two round, three-eighths and three-sixteenths diameter. Two half round, eight inches and four inches long. All files to be fitted with handles.

(11) Steel rule : twelve or six inches long. The six-inch is the most handy.

(12) Steel square : with blade about three inches long.

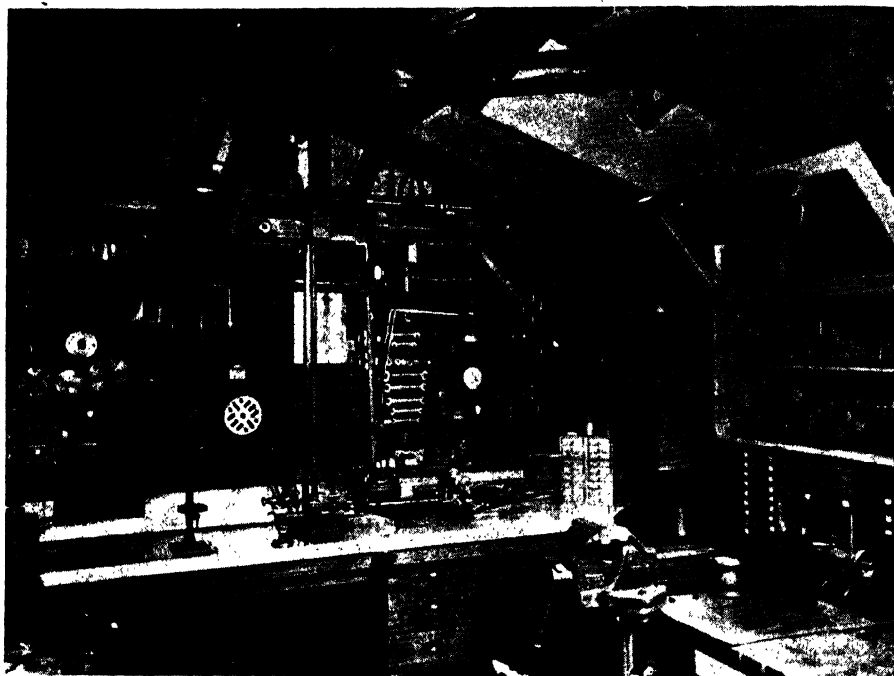
(13) Calipers : One pair of outside calipers, preferably with screw adjustment, capable of opening to four inches.

(14) Compasses, for marking circles on metal.

(15) Broaches : Though not strictly essential, are cheap and very useful. Six assorted sizes with handles. They are used for smoothing or enlarging small holes.

(16) Taps and Dies : For a start, I would suggest two circular dies, Nos. 3 B.A., and 6 B.A., with a holder to take these and all other B.A. sizes. One tap of each of these same two sizes, with the first two or three

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The private workshop of Mr. G. B. Cooper. Note the orderly arrangement of the small tools.

threads tapered off. Other dies and taps can be bought and added to the collection when wanted. A tap-wrench or hand-vice must also be included in this outfit.

(17) Hand drill brace : Of the egg-beater type, to take drills up to quarter-inch.

(18) Drills : A dozen assorted twist drills would lay a good foundation. I would suggest a quarter-inch diameter, and the following sizes on Stubb's gauge :—Nos. 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50. Since these form the nucleus for further expansion, they should be accommodated in a stand, preferably metal, with holes for all sizes from 1 to 60. If money is not plentiful, a home-made stand will serve the purpose ; a piece of hard wood, such as beech, being marked out for the complete set, but only drilled to take the sizes as they are purchased. Although the beginner may not be very successful in his first attempts to sharpen them when necessary, the means for doing so ought to exist ; [the next item is, therefore :

Miscellaneous Requirements

(19) "India" Carborundum slab.

(20) Solder, flux, and electric iron. An electric iron is not an essential ; model engineers were at work years before electric irons were thought of ; moreover, some localities still exist where there is no electricity. The old-fashioned iron heated in a fire or gas stove may be substituted. Solder and flux are essentials. Baker's fluid is one of the best fluxes, though "Fluxite" has the advantage of being non-corrosive. If, however, the work is washed with soap and water, and then rinsed in clean water after using Baker's fluid, there is not the slightest risk of rust or corrosion. If gas is available, a Bunsen burner will be admirable for nine-tenths of soldering jobs, the soldering iron being handy for the remaining tenth, especially for such things as joining wires in a wireless set. If there is no gas, a methyated spirit lamp makes a fair substitute.

This list of tools, not including the bench, could probably be purchased for £5 or less. Materials will, of course, be required, but would add little to the cost. They cannot be specified here as they will vary so greatly according to what the model engineer proposes to make.

(21) Drawings. The term "blue-print" is often applied to working drawings. This is merely a copy of a drawing made by a special photographic process. A tracing on transparent paper or cloth is first made from the original drawing. This tracing is used as a negative and a print is made from it on a sensitised paper, which when washed leaves the drawing in white lines on a blue background. By this process any number of copies can be made from a drawing quickly and at a small cost.

III

GENERAL ENGINEERING MODELLING

Some Examples of Interesting Work

IN introducing the reader to some of the aspects of general engineering model making, I think it is desirable in the first place to point out the difference between working and non-working models. The working model is usually a means to an end. That is to say, the model when completed is intended to be used in some way for the further pleasure of the builder. It may be a locomotive for running on a passenger track in the garden, or the power plant for a model boat or hydroplane, or the motive unit in a model aeroplane. Similarly, with work on a larger scale, not specifically a model, the product of the model engineer's skill may be an engine or an electric motor for driving his own workshop, a machine tool or some addition to his workshop equipment, or, as often happens, it may be some appliance of domestic utility which makes a welcome appearance in the household. The model engineer is very versatile in the application of his skill, and his hobby may have results which are either spectacular or utilitarian, or perhaps possessed of both these qualities.

The Purpose of Non-Working Models

The reader may ask—what is the use of a model which does not work? There are two answers to this question. In the first place, many non-working models illustrate some phase of engineering progress, or are of value as historical records or for educational purposes. It may be that the builder has a personal interest in some particular engine or ship and desires to possess a miniature for his own edification. Many of these models, though not put to any operative purpose, are complete in all their working details and, in the case of a steam engine, for example, would work quite satisfactorily under conditions similar to those of the prototype. It frequently happens, however, that such a model is preserved in a glass case, as a record of its intrinsic engineering interest and a

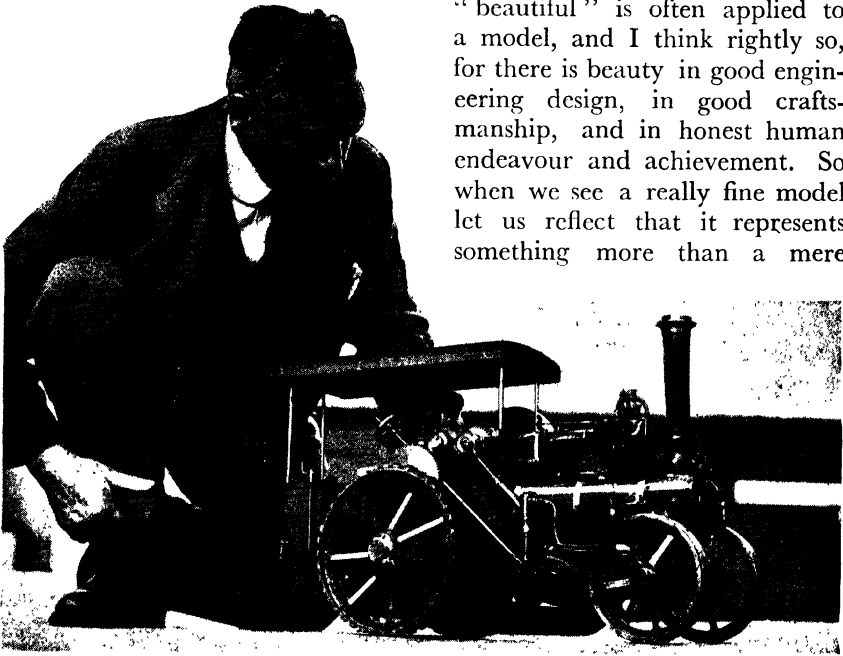
The Beauty of a Model

monument to its builder's patience and skill. It gives its owner a great deal of pleasure in the quiet contemplation of its perfection, and it recalls many happy hours spent in his workshop during its construction.

The Beauty of a Fine Model

Some time ago an ingenious model engineer advanced the theory of what he termed "model energy." He argued that during its course of construction a model absorbed the sensations of pleasure experienced by the builder, and, when completed, it radiated this pleasure energy to its owner and to other admirers, thus forming a constant reservoir of enjoyable memories and inspiration. I am not prepared to accept this theory of radiation as being confirmed in physical fact, but there is no doubt that a well-made model continues to give pleasure to many people who can appreciate its merits from a technical point of view. Just as a picture may give happy memories to the artist who painted it, and may by its beauty of conception or execution give pleasure to many other people, so a model has its power to please and interest. The word

"beautiful" is often applied to a model, and I think rightly so, for there is beauty in good engineering design, in good craftsmanship, and in honest human endeavour and achievement. So when we see a really fine model let us reflect that it represents something more than a mere



An excellent example of traction engine modelling by Mr. G. Wade, of Worthing. It is a first attempt at model engineering and represents two years' spare time work.

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structure of steel and brass and copper. It has a character and a charm which, if we are at all technically minded, will be readily apparent to our eyes and our inner senses.

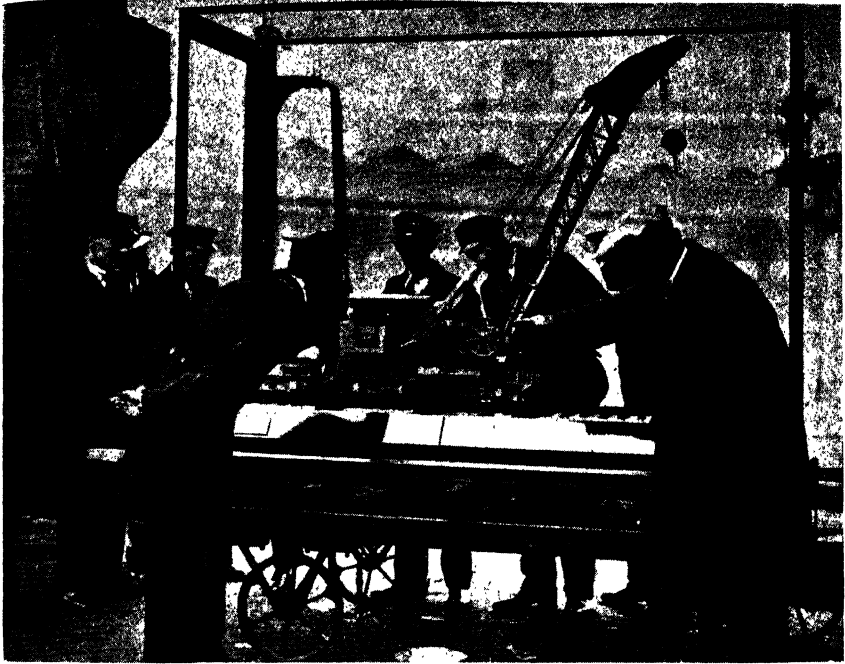
The Attraction of Machining and Fitting

There is a second answer to the question propounded at the opening of the previous paragraph. It is that many model engineers are primarily interested in the workshop operations involved in the building of a model. They enjoy working at the lathe, they are interested in the processes of drilling, and filing, and fitting the parts together. They find pleasure in being constructive engineers, and in reproducing in miniature the work of the real engineering establishment. This attitude of mind influences very largely the choice of a prototype to model. The builder likes something with plenty of machining and fitting work to do, and also likes a type of engine or machine in which the working parts are readily visible to the eye. The beam engines, mill engines, and marine engines of the Victorian era offer him a wide choice of suitable subjects and attract his interest more strongly than the enclosed types of engines which are representative of present-day practice. The traction engine is a very popular type of model for this reason, since it is complete as a power unit and all its motion work is readily visible. Moreover, if desired, it can be put under steam and demonstrated in the garden without requiring the space or the track necessary for running a steam locomotive.

The beginner, who may have visions of constructing a very elaborate model, would be well advised to try his prentice hand on something quite simple. There are inexpensive sets of castings and parts on the market which make up into good-looking engines and offer opportunity for gaining experience in the use of tools and processes. If parts are spoiled, as some may be in the initial stages, they are not difficult or costly to replace, and the knowledge and handicraft skill acquired in this elementary work will have been well worth while. The pleasure derived from the satisfactory completion of a model, however simple, is very real, and the beginner may then embark on the more elaborate production on which he has set his heart, with a corresponding degree of confidence. If he aims too high at the beginning he may find the work beyond his powers and may become unnecessarily discouraged.

Before starting to build a model the beginner should have a clear conception of what it is he is going to make, and the purpose and character of its component parts. If he buys a set of castings a working drawing will probably be included, or may be procured as an addition. Alternatively, he may decide to build something from drawings published

A Perfect Crane Model



A perfect scale model of an L.M.S. "Craven" travelling breakdown crane, made by Mr. S. Ward, of Northampton. It took eighteen months to build and will lift $1\frac{1}{2}$ cwt. Mr. Ward is seen explaining the model to a group of railway officials at Euston Station.

in *The Model Engineer*, or in some text-book. But, in any case, it is important that he should study the job beforehand and understand what the castings and bits and pieces are for, and where they are to go in the completed model. This preliminary examination of the work to be done will in all probability save him from making mistakes and wasting material. Engineering drawings are not difficult to understand, and the time taken in elucidating their details is well worth while.

Models in Miniature

The reader unaccustomed to mechanical work might be pardoned for imagining that the smaller a model is the easier it would be to make. As a matter of fact, the exact opposite is the truth. Very minute work is difficult to see and to hold, the shaping and fitting of the parts must be most exact, and the slightest error when turning or filing may ruin that particular piece. If you have looked at the works of a lady's wrist watch

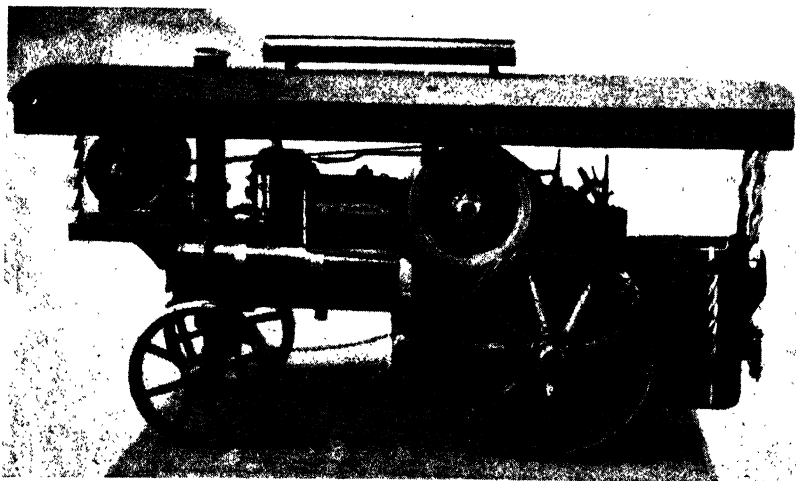
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you will appreciate what fine mechanical work really means, and you have no doubt all seen the watch repairer at work with a magnifying glass in his eye. Fortunately, model engineering does not call for such microscopical detail, except in special cases of instrument making or experimental work. The watchmaker of today has his work very much simplified by the availability of machine-made parts.

There will always be some craftsmen for whom the miniature production has a fascination, and I have seen some remarkable examples of skill in this direction. Working model engines have been built which would easily stand on a sixpence, and might be described in terms of fly-power rather than horse-power. If I were asked who had built the smallest engine in the world, I should have to say I did not know, for, however small an engine may be made, there is always someone who comes along and claims to have made one still smaller.

A Tie-Pin Model Engine

I remember a visitor stopping to talk to me at a *Model Engineer* Exhibition. While we were talking I noticed something moving on his necktie. I looked more closely, and there I saw, as a tie-pin, a tiny vertical engine, the flywheel of which was busily revolving as we talked. It was operated by compressed air, the source of which was an india-rubber bulb concealed in his waistcoat pocket, and connected to the



A model of a showman's traction engine for fair-ground service. Built by Mr. A. Colquhoun. $1\frac{1}{4}$ -in. scale, 2 ft. 6 in. long, 1 ft. 3 in. high. Coal-fired boiler. Fitted with a dynamo at the front for electric lighting.

Compressed Air Driving



A model naval quick-firing gun. It fires the model shell shown standing on the base.

engine by a thin rubber tube. When he pressed the bulb with his elbow the engine worked.

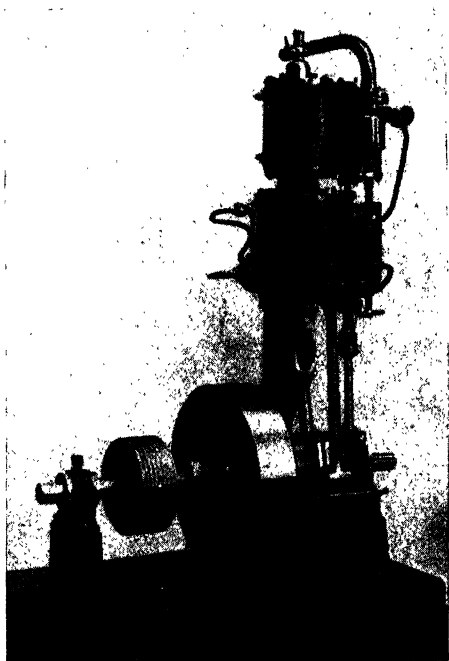
Compressed Air Driving

Compressed air for driving model engines is frequently used for experimental or demonstration purposes. An elaborate and highly finished model intended to be housed in a glass case, would, if subjected to the action of steam,

suffer from corrosion and the exuding of oil on its finished surfaces, but, if compressed air is adopted, the engine can be shown in motion without these attendant troubles. Many interesting models in the Science Museum are supplied with a service of compressed air, and pressure on a button on the exterior of the glass case opens a valve which admits air to the cylinder of the engine and sets it in motion. Similarly at many model engineering exhibitions, the models are shown in motion by a compressed air supply from a cylindrical container, or from an air-compressor operated by an electric motor. Compressed air is not an efficient substitute for steam where continuous power is required, but it has been applied with some success to small motors for propelling model aeroplanes.

How Steam Engines Work

Steam engines may be either "single-acting" or "double-acting." In the former type the steam acts on one side of the piston only, the other



Model of a vertical compound tandem cylinder steam engine.

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end of the cylinder being open to the atmosphere. These engines are usually fitted with an oscillating cylinder which rocks to and fro against a flat surface in which holes, or "ports" as they are termed, are drilled for the admission and release of the steam. The oscillating cylinder is frequently found on very simple and inexpensive types of models, running at high speed but giving comparatively small power. In real engineering practice, oscillating engines have been used in paddle steamers with considerable success, but while the oscillating principle was the same the details of design were more elaborate to enable the engine efficiently to fulfil its special purpose.

In a double-acting engine the steam acts on each side of the piston alternately, and the admission and release or exhaust of the steam is controlled by a slide-valve. This slide-valve works in a steam chest on the side of the cylinder and opens or closes ports which communicate with passages leading to the interior of the cylinder or, at the correct moment, with a passage to the exhaust pipe. The slide-valve receives its motion from an eccentric which is keyed to the main crank-shaft of the engine and revolves with it. When an engine is intended to reverse the direction of its motion, it is necessary to change the sequence in which the slide valve covers or uncovers the ports in the steam-chest. This may be achieved in one of two ways. With very simple engines it is done by the use of a slip-eccentric. In this method the eccentric is loose on the main shaft to the extent that it can change its position for driving the slide valve by being turned through a limited distance backwards or forwards. The amount of its adjustment in position is controlled by stops or pins fitted to the main shaft in correctly spaced places. The cheaper kinds of steam locomotives are sometimes provided with this method of reversing, the engine being pushed a little one way or the other to cause the eccentric to change its position.

A more elaborate arrangement for reversing involves the use of two eccentrics on the main shaft, each being keyed in the correct position to drive the engine one way or the other. These eccentrics are connected by rods to the ends of a swinging link in which there is a curved slot. In this slot there is a sliding block to which is attached a rod connected to the slide valve. A reversing lever attached to the link enables it to be moved in position so that the motion of the slide valve rod is controlled by one or other of the eccentrics, according to the direction in which it is desired that the engine should revolve. The motion of that particular eccentric is imparted to the valve rod through the medium of the sliding block in the link, the position of which at one end or the other is changed. When the reader sees the letters d.a.s.v. in a description



An exceptionally complete model of a rescue service lorry. 19½ in. long, one-inch scale. Note the detailed equipment all modelled to scale. Made by Mr. G. Goodbourn.

of an engine, he will know that it means “double-acting slide valve.”

I give these simple explanations of steam engine construction because those readers who are approaching the subject for the first time might otherwise be at a loss to understand references to engines of various types and various degrees of complication as given in model supply catalogues, or in the descriptions of models in this book. A few minutes' contemplation of drawings or photographs of engines, with these points in mind, will do much to enable the reader to understand and appreciate the character of a particular model or real engine.

A Simple Experimental Engine

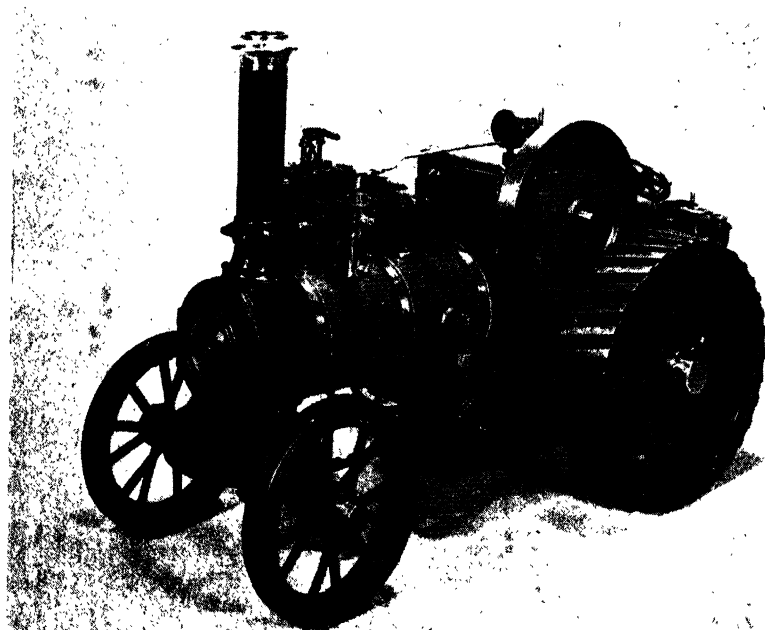
The steam engine in its many forms is a very interesting study and the hobbyist will find that as he progresses with his various models the door will be opened to much new knowledge and attractive research, and even to some adventure in original experiment. Take, for example, the photograph on p. 55 of a simple oscillating cylinder engine made by Mr. S. W. Simpson. In this design the builder has departed from the normal method of taking the steam supply and has mounted the cylinder on a hollow trunnion at the base of which a piston-valve regulates the admission and expansion of the steam. The upper end of the cylinder is closed and the air on that side of the piston is compressed into a jacket or annular space surrounding the cylinder itself. The air so compressed becomes very hot, and on the down stroke of the piston it gives up the power stored in compressing it. In this way the engine becomes double-acting in effect.

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In trying this engine out, Mr. Simpson found that, while it ran for a time very quietly, at high speed it would later begin to labour and slow down. He eventually found the trouble to be caused by a small amount of vapour working past the piston, where it condensed and passed into the jacket. In time the jacket filled up, and there was no space left into which to compress the air. He solved the difficulty by drilling a tiny hole at the bottom of the jacket so that after every dozen strokes or so a drop of water was ejected. The size of this interesting little steam plant may be judged from the dimensions of the boiler, shown alongside, which are 6 in. high by $3\frac{1}{2}$ in. diameter. This engine is only a modest piece of model engineering, but it is of particular interest as showing the scope for intelligent experiment which even a very simple type of engine can afford. Mr. Simpson proposes to build a larger edition in the near future and continue his experiments with a view to obtaining more perfect results.

About Boilers

It is obvious that a steam engine will not do regular work without a boiler to supply the steam and, if the model maker desires that his engine



A working model traction engine, one-inch scale. Built by Mr. Jacobs from "The Model Engineer" blueprint.

A Simple Experimental Engine



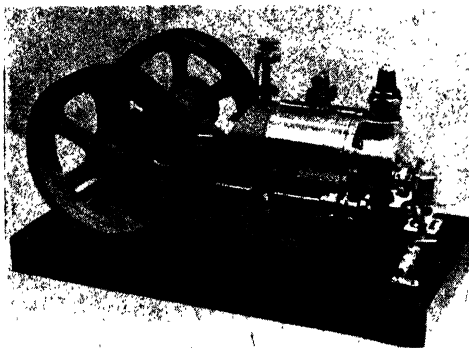
Mr. S. W. Simpson explains his model experimental steam engine at a meeting of the Society of Model and Experimental Engineers.

should drive a dynamo or a pump, or a boat, or serve some other useful purpose, he must consider making a boiler. This is not a difficult task, but it calls for a different kind of craftsmanship. Sheet metal has to be rolled into shape, and to be drilled and riveted. The joints will need soldering or brazing to prevent leakage, and there will be tubes and pipes to be fitted. Certain fittings such as a stop-valve for controlling the supply of steam, a pressure gauge, a water gauge, and a safety-valve will also be needed. These fittings may be purchased ready made, or may furnish the hobbyist with some additional exercise for his skill. In a locomotive or a traction engine the boiler is naturally a very important feature around which the general structure of the engine is built, but it by no means follows that every model engine should be fitted with a boiler. Many model makers are satisfied with building the engine only, as a piece of craftsmanship, and there is not much point in making a boiler unless steam is actually required for working purposes.

Choosing a Prototype

As a first effort a simple form of vertical or horizontal engine is very appropriate, and the type of vertical engine used for driving steam launches is deservedly popular. It is the baby of marine engines, but there

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A very neat working model gas engine.

is no limit to the magnitude and complexity of the marine engine as the propelling power of boats and ships of all sizes. The simple launch engine will have only one cylinder, but the engine of the large cargo boat or liner may have three or even four cylinders, with a corresponding multiplicity of pistons, valves, connecting - rods and cranks, affording fascinating scope for the skill and ingenuity

of the model maker in machining and fitting the various parts. As an example of good marine engine modelling I should like to quote the compound condensing engine made by Mr. S. R. Harris, of the Kodak Recreation Society. This is built to the scale of 1 inch to the foot and well illustrates the opportunity afforded by a marine engine for interesting craftsmanship and for the possession of a handsome and most attractive model. The older types of marine steam engines are gradually passing out of existence owing to the competition of the steam turbine and the internal combustion engine, but those used during the last eighty years provide a wealth of subject matter for the model maker's attention which he can explore with unending interest when in search of a prototype for his skill. Broadly speaking, the engines used in paddle steamers and in screw-propelled vessels belong to two different categories, each with its own special features of interest, and each providing attractive subjects for the model maker. There is a splendid collection of marine engine models in the Science Museum in South Kensington which will amply repay some quiet study.

The beam engine, so largely used during the last century for driving the machinery of textile mills and waterworks pumping plants, offers another most interesting field for good modelling. These engines, massive in design and slow-running in operation, occupy an important place in the history of steam engine development and have a well-deserved corner in the hearts of model engineers. In 1914 *The Model Engineer* published a coloured plate of a well-designed engine of this class, and this has inspired many readers to build a model. I was much pleased by the effort of Mr. G. T. Williams, of Stokenchurch, to profit by this design, and I think I may truly say that not only is the engine very effective in appearance, but that he has put some first-class workmanship into his model. Another

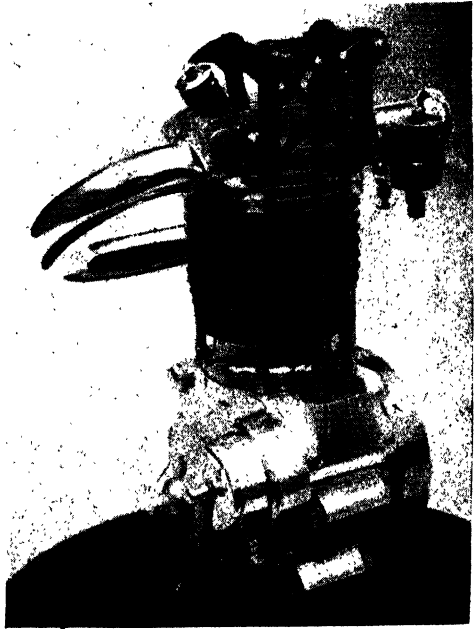
Choosing a Prototype

excellent example of beam engine modelling may be seen in the work of Mr. F. J. Woodward, illustrated in the later chapter on *The Model Engineer* Exhibition. Beam engines in real life have been almost entirely superseded by the electric motor, but their charms will for many years to come be revived in the workshops of model engineers.

The reader who explores early text-books on the steam engine will find a multitude of designs to arouse his interest. The vertical engines of the "table" or "steeple" type, largely used for the driving of factory machinery requiring comparatively small power, were very handsome in appearance and afford plenty of scope for neat workmanship and finish. Horizontal engines of every type and size were much used for mill and factory driving, and for large powers the very impressive "Corliss" and "drop valve" engines were admirable examples of design and construction. Colliery winding engines for raising and lowering the cages in the pit shafts afford another interesting field for search for an attractive prototype. Agricultural machinery will naturally have a strong appeal to the model maker who is fond of the countryside. Steam traction engines may still be seen on farms and on the roads and the accompanying photograph of the work of Mr. Jacobs, of High Wycombe, will show what a handsome model of this kind can be built. Blueprint working drawings of a 1-in. scale model of this design, by Mr. Henry Greenly, are obtainable from the offices of *The Model Engineer*.

Model Petrol Motors

The remarkable development of the internal-combustion engine in recent years presents a most absorbing prospect not only for modelling engines used for marine propulsion, aviation, and road transport, but for experimental research in designing and building working engines of small power



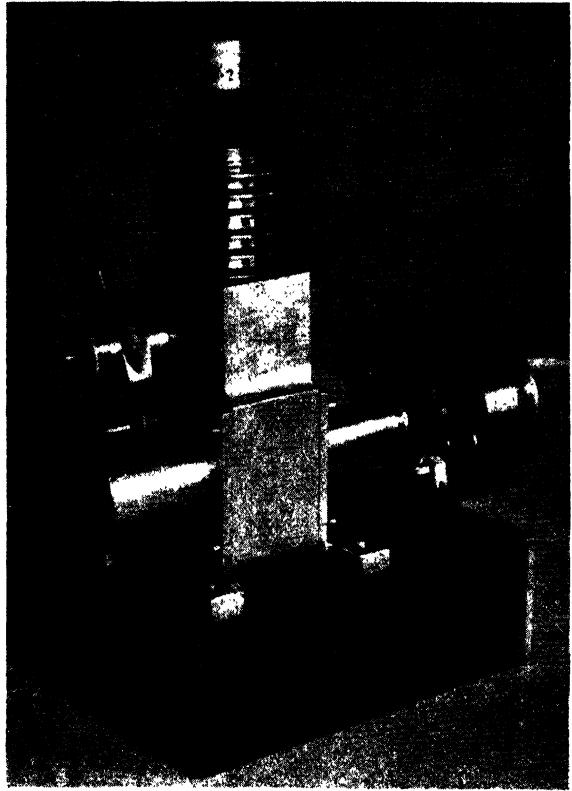
Small power petrol engines are very popular with model engineers. Here is an example of the high-grade workmanship incorporated in a successful model.

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for model speed-boats, aeroplanes, and motor cars. Much thought and patient investigation have been bestowed on the design of these miniature petrol engines to ensure their efficient working, and exceptionally satisfactory results have been achieved. A number of model engineers have given their attention to the problems involved, and my colleague, Mr. Edgar T. Westbury, has by his own scientific approach to the subject and by his constant designing, building, and testing of engines made many important contributions to progress in this field of experimental work. His articles in the pages of *The Model Engineer* have aroused wide-spread interest and appreciation, and he has established a unique reputation as an authority on the small petrol motor.

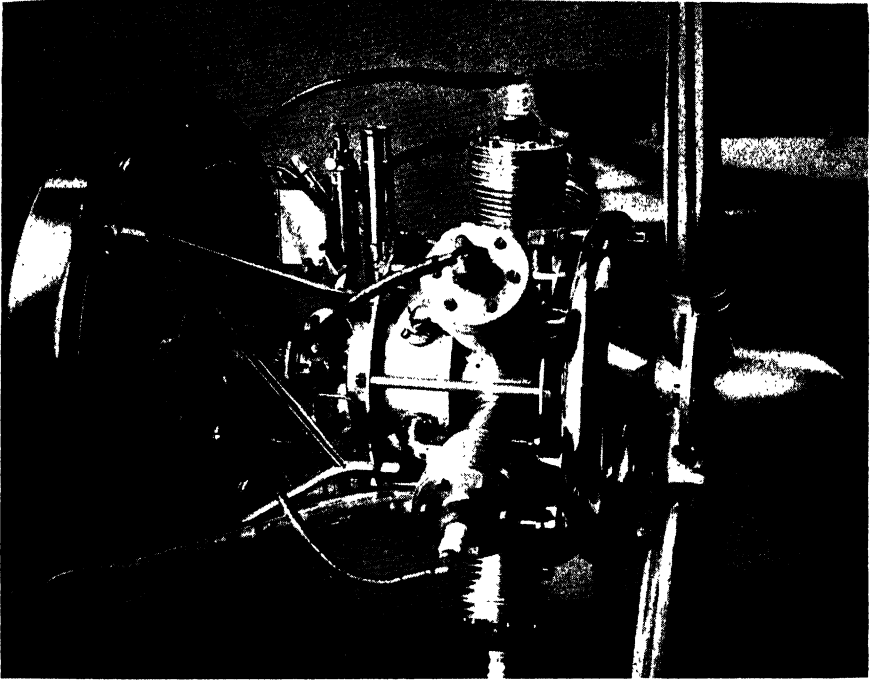
Gas and Oil Engines

Engines operated by gas or oil fuel form another section of internal-combustion engineering which offers scope for the model maker. Small power engines of this type are very suitable for driving lathes and machine tools in the home workshop, although, where current is available, the electric motor has obvious advantages. Full-size gas and oil engines, however, are attractive as prototypes for the model maker and I am pleased to be able to give a photograph of a most realistic model of a "Crossley" Diesel oil engine made by Mr. Amos Barber, one of the leading experts in the Bradford Society of Model Engineers. To



A remarkable miniature working petrol motor. The cylinder has a capacity of one cubic centimetre. The model is shown standing on an ordinary matchbox.

A Fine Model Aero Engine



**A model 7-cylinder aero engine ; a beautiful example of amateur workmanship.
Made by Dr. Fletcher.**

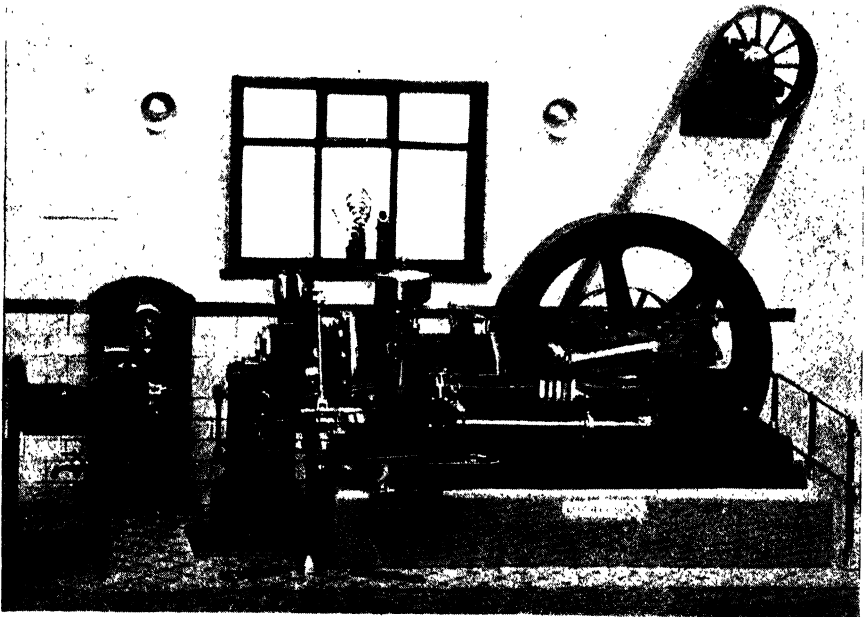
look at the photograph, one would imagine that it represented a full-sized engine in its proper engine-room surroundings. It is surprising, therefore, to be told that the cylinder only measures 1 in. bore by $1\frac{1}{2}$ in. stroke, and that the overall length of the model is $9\frac{1}{2}$ in. The model works with beautiful regularity and smoothness. It starts up within two minutes of lighting the gas, and will run as long as desired at any speed from 50 to 250 revolutions per minute, according to the height of the flame in the Bunsen burner. Mr. Barber has added to the realism of his model by making a tiny vice-bench, and a complete array of miniature spanners, oil cans, and other small tools usually to be found in an engine room. The principal castings for the model were made from Mr. Barber's own patterns ; the drawings were supplied by the courtesy of Messrs. Crossley Bros. Ltd. Although his engine is such an excellent working model, the power developed is not sufficient to render it suitable for the regular driving of a workshop or other machinery. It does, however, demonstrate that the essential working features of a real engine can be successfully reproduced

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in miniature and, whether the baby engine is required to do real work or not is only a question of its dimensions. Mr. Barber's model is a real triumph of mechanics in miniature.

Special Castings

The model maker who looks outside the field of commercial sets of castings for his subject may wonder how to set about obtaining such special castings as are required for the prototype he has selected. This involves the preparation of patterns, usually in wood, from which the mould for the castings can be made. Some model engineers are enterprising enough to make their own castings, but the usual procedure is to make the pattern and take it to a local foundry for the casting to be made. Patterns need to be made slightly larger than the actual casting which is required. This is to allow for the contraction or shrinkage which takes place when the metal cools. Patterns must also be made larger in certain places to provide for the machining or filing of the casting to the exact size required.



Would you think this was a model? It is a perfect replica of a "Crossley" diesel oil-engine in its engine room surroundings. It is only $9\frac{1}{2}$ in. in length, yet it works with the utmost smoothness and regularity at any desired speed. Note the engineer's vice-bench at the left of the picture, the spanners on the floor, and the flower in the window. Made by Mr. Amos Barber, of Bradford.



Model motor car racing is a recent development of the hobby. Here is a group of enthusiasts with their cars on the roof of a London building. Petrol is the power used.

Thus in a cylinder intended to be bored out to a finished diameter of $1\frac{1}{2}$ in. the hole in the rough casting would be $1\frac{1}{4}$ in., thereby allowing $\frac{1}{8}$ in. all round to be removed in the finishing process. Small details of model engines which, in real practice, would be castings, are often cut or machined from solid metal, to obviate the difficulty of making patterns and castings to such a small scale. Castings for frames and bed-plates, and other large parts may also be dispensed with by building up the shape required from pieces of solid metal, accurately cut to size and soldered or brazed together. Nicely painted, such built-up parts cannot be distinguished from castings and often get the model maker out of a difficulty in regard to pattern making and foundry work.

The Vast Field for Model Making

With a hundred years of engineering progress to draw upon, the model maker need never be at a loss for an interesting prototype to copy. In mechanical engineering, in addition, to the examples I have already indicated, there is a wide range of textile and general industrial machinery, hydraulic gear, pumps, cranes, lifts and fire-engines, while in civil engineering attraction may be found in bridges, docks, harbours, exca-

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vators, “ bull-dozers,” mining equipment and the hundred and one pieces of plant employed by man for the enjoyment of the varied natural resources of the world. The mechanisation of the armed forces has brought into being a whole series of tanks, motor vehicles, and mobile and anti-aircraft guns which, however much one may detest war, affords a new outlet for model-making ingenuity, while the field of naval gunnery is a study in itself. There is, in fact, an endless series of answers to the question “ What shall I make ? ” The precise answer will be found when the hobbyist says to himself, “ That is interesting ; I should like to make a model of it.”

IV

THE WORK OF A DISTINGUISHED MODEL ENGINEER, DR. J. BRADBURY WINTER

I N devoting a separate chapter to the work of Dr. Bradbury Winter, I am departing from my original intention of including his models in the previous section dealing with engineering subjects in general, but since his work represents the life-long activities of one model engineer, and since it includes subjects as diverse in character as locomotives, calendars, and clocks, and is unique in its perfection, I feel sure it is better presented in a literary glass case of its own. By giving it this prominence I am risking the Doctor's displeasure, for when he very kindly sent me some photographs for the illustrations he expressly stipulated that I was not to make this a "Bradbury Winter book." His mind will be relieved when he sees how wide is the range of model engineering achievement covered in this volume and that the spotlight of publicity has deservedly fallen on so many of his fellow-enthusiasts. I realise the implication that, while I may describe his work as I please, I must preserve a discreet restraint in my references to the Doctor himself. To obey my instructions I will not go beyond saying that he is the most charmingly modest of men, a genius in the workshop, and a valued friend and correspondent for over forty years. That much must be said, and so I will leave it now to the models themselves to tell their own remarkable story of the ingenuity and ability of their builder, with such little prompting as my pen can give.

His First Adventure—The Locomotive "Como"

Apart from the construction of two small horizontal steam engines of a comparatively simple character, Dr. Winter's first adventure in serious model making was to build a miniature of the "Como," a D2 class locomotive of the old London Brighton & South Coast Railway. This was a 0-4-2 engine; that is, having no leading bogie but two pairs of coupled driving wheels, and a pair of trailing wheels. It was an engine of very pleasing outline, and a very attractive subject for the prospective modeller. I suppose I have seen as many model locomotives as most

The Work of Dr. J. Bradbury Winter



Dr. J. Bradbury Winter at work at his five-inch lathe.

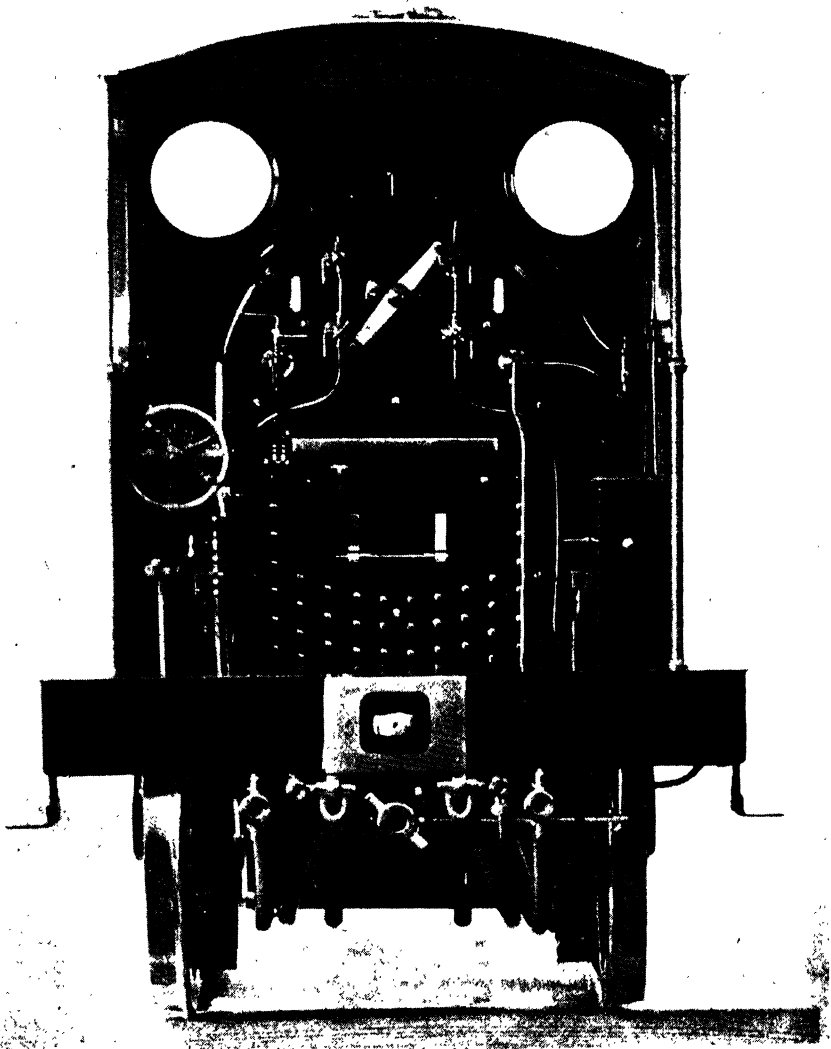
people, both professional and amateur made, and quite a number of them have been of a very high standard indeed. But I cannot recollect a model which gives me the same impression of absolute perfection in both scale and detail as does the "Como." I have seen the "Como" on many occasions and have always experienced an uncanny feeling that the real engine has shrunk to model proportions without sacrificing in the smallest degree its original character or atmosphere. I am sure this feeling has been shared by the many railway engineers who have had the privilege of seeing it and sub-

mitting it to a critical examination. Let me relate a few facts about the building of the model, which will help to explain how this sense of perfection has been achieved.

Twenty Years' Work on a Model

In the first place I must record that the model "Como" is built to a scale of 1 inch to the foot. Its over-all length, including the tender, is 4 ft. 2½ in. The model took twenty years of spare time to build, the engine absorbing the first thirteen years and the tender a period of seven years longer. In those days Dr. Winter, in the intervals of a busy professional practice in Brighton, managed to spend a thousand hours or so each year in his workshop. The grand total of time devoted to this model would, therefore, be twenty thousand hours. I think I can best illustrate the absorption of so much time by quoting the remarkably patient method

The Model "Como"



Inside the cab of the "Como" model locomotive. The perfect scale modelling of the cab fittings should be noticed. In accordance with the Brighton Company's practice, Dr. Winter's name, as driver, is inscribed in the cab.

The Work of Dr. J. Bradbury Winter

he adopted for obtaining perfect wheels. In the early stages of the building of the model, wooden patterns were made for the wheels, and from these patterns castings in iron were obtained. They, however, did not satisfy Dr. Winter's meticulous requirements, for the corners were all rounded and no amount of filing made the spokes look really clean. The castings were, therefore, put aside and the wheels were cut out of the solid from forged discs of mild-steel. These discs were first of all faced up in the lathe to fit templates, and the holes for the axles were bored. Then the spokes were marked out, small holes drilled round the lines, and the spaces chiselled out and finished with a file. This method of making the spokes necessitated the drilling of more than 700 holes in each wheel, and the time occupied in completing the six wheels was over 500 hours. Thus, on the assumption that Dr. Winter spent three hours a day in his workshop, it must have taken him the best part of six months to make the wheels alone. This may seem a prodigious expenditure of time on one detail, but in the result the "Como" has wheels which, in exactitude and appearance and finish, are rivalled by no other model, and the work was not a task but a labour of love. To complete the wheels, steel tyres were shrunk on and fixed in the usual way with a screw in each alternate interval between the spokes. The wheels were driven on the axles in accordance with the usual practice in the Brighton Railway Works, and no keys were used. This method of cutting parts out of solid metal was also employed for a number of the smaller details which, though formed from castings in the real engine, were too small for making satisfactory castings of model size.

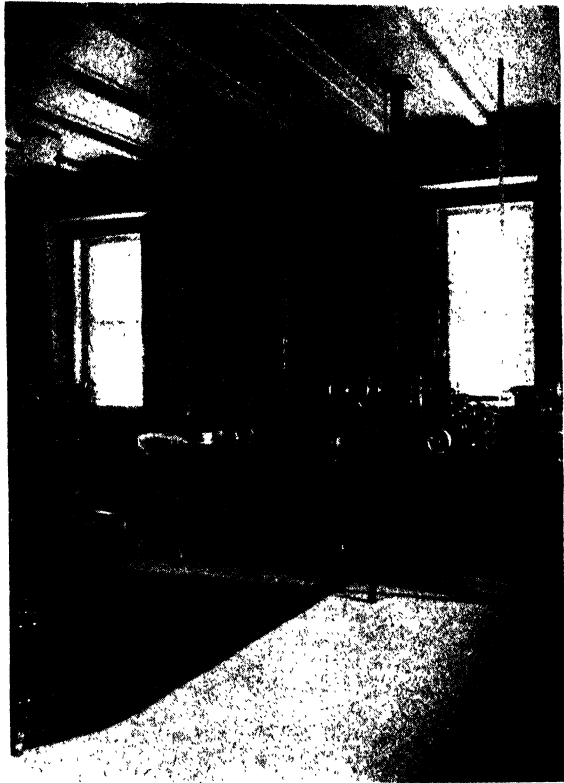
The Boiler of the "Como"

The boiler is an exact replica of the real thing. It contains 262 tubes, each $\frac{3}{8}$ in. outside diameter, and the firebox has the same number of stays and rivets as the real engine, all correctly spaced to scale. Model locomotives built to work under steam are fitted with a much smaller number of tubes of larger diameter, a modification in design necessary to ensure efficient steam raising. But though the "Como" is built as a faithful replica of the prototype in all respects, and therefore has this large array of boiler tubes, the chassis has many times been worked under steam supplied from a separate boiler. It took five years for the engine to reach this stage. The covering for the steam dome is another example of patience and accurate work. This covering is a shell with a cylindrical body and spherical upper end, and is only one ninety-sixth of an inch thick. It was turned and bored out of a solid piece of steel a little larger in diameter than the outside dimensions of the finished dome, $2\frac{1}{2}$ in.

The model is complete down to the smallest nut and check pin. The nuts were all home-made, and some of them are only $\frac{1}{16}$ in. in diameter. The check pins are in some cases as small as No. 70 on the steel wire gauge, and many of the screws on the pipe unions have threads as fine as one hundred to the inch.

When the construction of the engine had been completed, it was necessary to take it all to pieces for the purpose of painting, fine-lining and varnishing. The re-erection of the engine alone, after this work was done, occupied 150 hours, or about two months of spare time.

The short length of permanent way on which the engine is mounted has been reproduced to scale and in appearance as faithfully as the locomotive itself.



A corner of the drawing-room workshop at Dr. Winter's mountain home in Switzerland.

Building the "Como" Tender

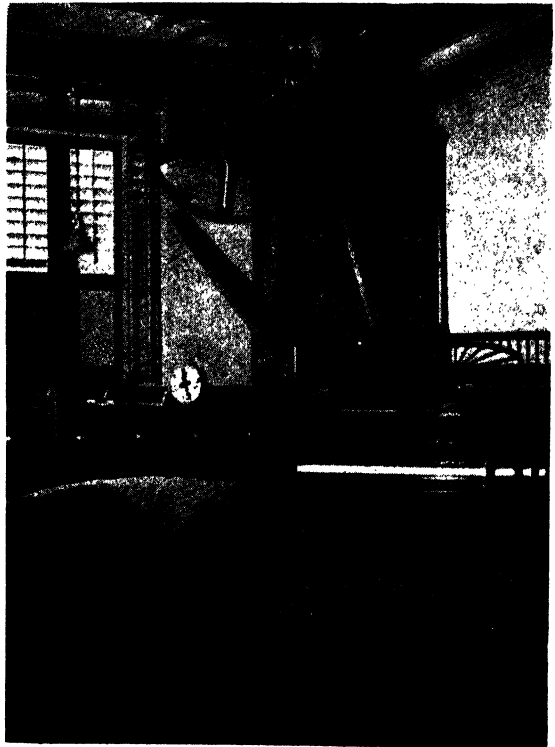
Having completed the engine, there was an interval before starting work on the tender, a job which was to occupy another seven years. In its external appearance, a locomotive tender looks a comparatively simple affair, but there is a lot of internal detail which the eye does not normally see. This is revealed in the photograph I reproduce of the tender in course of construction. So perfect did Dr. Winter determine his model should be that he spent many hours inside the tender of the real "Como" making sketches and taking measurements. He has since

The Work of Dr. J. Bradbury Winter

confessed to me that he had moments of anxiety lest someone should come along and close down the water-filling lid without knowing that there was an occupant inside !

Some Small Clockwork Locomotives

In the interval just mentioned between the finishing of the engine and starting of the tender, Dr. Winter was occupied in building some small clockwork locomotives for his friends, the brothers Dr. Arthur and Dr. Gerald Hovenden. These brothers had built a small-scale model railway representing the L.B. & S.C. layout between London Bridge, Victoria and Croydon so accurately, with its various tracks, cross-overs and bridges, that trains could be operated to correspond with the running scheduled in the Company's time-table. Being rather disturbed by the irregular working of the ordinary clockwork locomotive, they consulted Dr. Winter, who forthwith undertook to build a locomotive free from this defect. Altogether, he built half a dozen such engines, representing the various types in use on the Brighton Railway. They were fitted not only with most efficient clockwork mechanism, but with a governor gear which regulated the speed of the engines up and down hill, and on the level. One of these engines was sent to the *Model Engineer Exhibition* of 1902, where it gained a silver medal, the highest award at that time.



Music and mechanics—an unusual combination of workshop interests.

Making a "Congreve" Clock

Making a "Congreve" Clock

After finishing the "Como" tender, Dr. Winter was fully employed for three and a half years as works manager of a munition factory during the first world war. Subsequently he turned his attention to horology and built a revised version of the well-known clock designed by Congreve rather more than a hundred years ago. In the original clock a novel form of escapement was employed. Instead of regulating the speed of the clock train by means of a pendulum, an inclined plate was used, on the surface of which a zig-zag groove was cut. In this groove there ran a steel ball which traversed the plate from one side to the other. When this journey had been completed, the plate was automatically tilted in the opposite direction and the ball returned to its starting point. The time taken for the ball to make its journey governed each movement of the clock train. The inclined plate was mounted in a shallow glass case on the top of the clock, so that the movement of the ball could be observed, and so fascinating and mysterious did it become that many beholders gained the impression that a solution of the problem of perpetual motion had been found. Far from this being the case, this escapement required a considerably heavier driving weight than an ordinary clock. Dr. Winter, however, in a humorous vein, stimulated the puzzlement of the spectator by fitting an automatic electric motor winding arrangement which would keep the clock going indefinitely without attention, until some part should wear out or give way.

The clock in its original form was not a good time-keeper, but here again Dr. Winter's ingenuity came to the rescue in the fitting of a synchronising mechanism by which the hands are adjusted to their true position every half-hour. This mechanism, which is electrically operated, is controlled from a separate small clock of known good time-keeping qualities, which need not be in the same room, or indeed in the same house, provided a suitable electric circuit is arranged. The Congreve clock was completed in 1922. With Dr. Winter's improvements, it is a handsome production, now giving good time-keeping service, and is a triumph of mechanical ingenuity and skill. It is a source of great interest to his many friends.

A Remarkable Perpetual Calendar

After this excursion into horology, Dr. Winter next turned his thoughts to the construction of a perpetual calendar, controlled by a most ingenious interlocking mechanism. This, too, had a railway flavour, as it was operated by the pulling over of hand-levers similar to those in a railway signal-box, although, of course, much fewer in number. There were nine

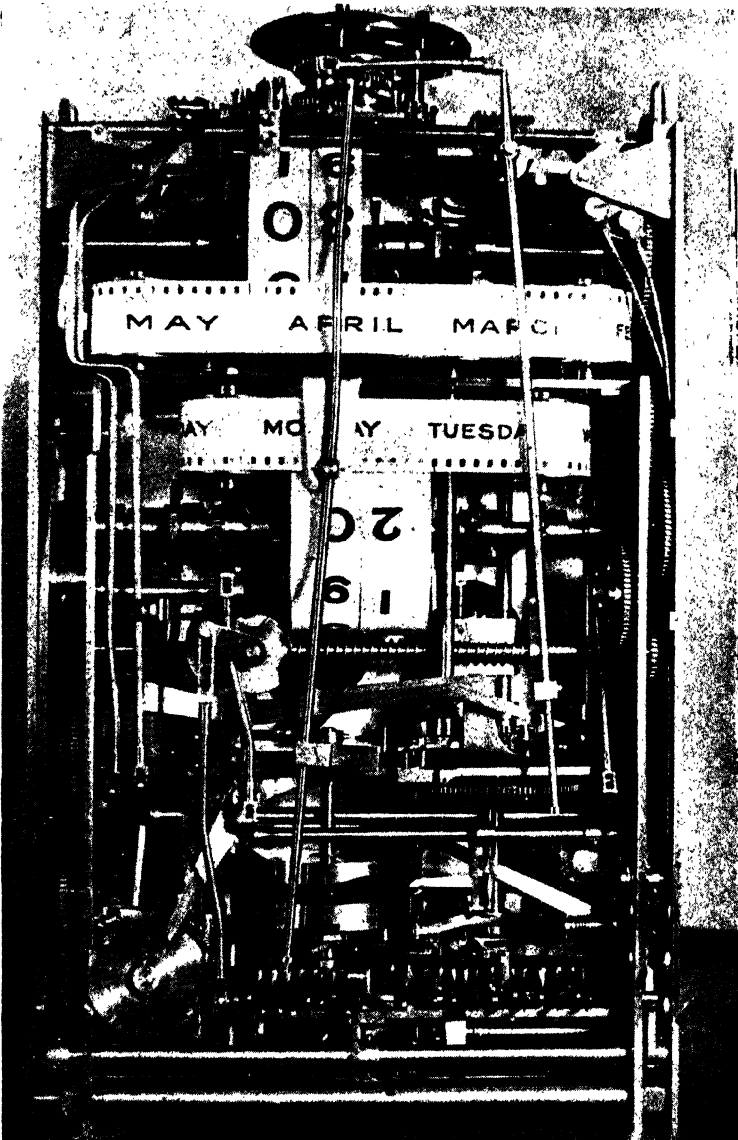
The Work of Dr. J. Bradbury Winter

such levers in all, each corresponding to one set of figures or words. This calendar was really a box of brains ; it did all the thinking for you about the difference in the length of months, the effect of leap year, etc. It also reminded you of engagements for particular days, and even rang a bell at a fixed hour every morning to call you to pull the levers to set the dial for the day. You could not forget to set it, for this obstinate bell continued to ring until you had done so. Nor could you make a mistake in pulling the levers, for you could only move those which were right for that particular day, the others being automatically locked. Once set, all the levers remained locked until setting time on the following morning. Two of the levers were "reminding levers," which would bring into special windows on the front of the cabinet devices to jog your memory about engagements, or something of which you wished to be reminded. If you had an engagement for some days ahead, all you had to do was to put a small plug in the hole corresponding to the date of your engagement, and when that day arrived the bell would continue to ring after you had set the levers. Any number of engagements up to a month ahead could be registered in this way. But if two engagements happened to fall on the same day, a special type of plug was used (having a distinguishing colour) which kept the bell ringing until both engagements had been noted and checked off.

I give a photograph showing the interior of this remarkable calendar with the back of the case removed. The complexity will be apparent, but it never fails to work and leave you to wonder not only at its ingenuity but at the problem of fitting it together once the various parts were made. There is far more mechanism in it than can be seen in the photograph. There are, for example, some ninety toothed gear wheels for producing the various movements. These were all cut from the solid by the builder.

Although Dr. Winter designed all the mechanism of this calendar, he would be the last to claim the entire credit for its construction. The calendar was built at his mountain home in Switzerland, and he was fortunate in having Miss C. Mackworth as a resident guest. I say fortunate because Miss Mackworth, under his tuition, developed a remarkable degree of mechanical skill, and cheerfully undertook to relieve him of much of the constructive detail involved. In the first place it was intended to make only one calendar, this for his friend, Dr. Hovenden, whose railway mind conceived the signal-box layout. Then the doctor thought that he would like to have one of the same design for himself. Miss Mackworth, being brought into consultation, also put in a claim for a calendar, and very sportingly agreed to get busy on making the parts in triplicate. I have seen some examples of Miss Mackworth's

A Perpetual Calendar



The interior mechanism of Dr. Winter's remarkable perpetual calendar. An example of ingenuity and meticulous craftsmanship.

The Work of Dr. J. Bradbury Winter

workmanship, and if I say that they could not be distinguished in accuracy and finish from those produced by Dr. Winter himself, their high quality will be readily appreciated. Miss Mackworth later rendered valuable collaboration in the construction of the "Silver Rocket" locomotive, the story of which is now to follow.

The Story of the "Silver Rocket"

In the spring of 1929, Dr. Winter was asked by Mr. Loughnan Pendred, then President-Elect of the Institution of Mechanical Engineers, if he would consider building a model of the famous locomotive, the "Rocket." Mr. Pendred had in mind making a gift of such a model to the Institution, of which George Stephenson, the inventor of the original locomotive, was the first President. Mr. Pendred suggested that as a presentation and decorative model it should be built in silver. Moreover, he was anxious to find some amateur craftsman who would undertake the work for sentimental reasons, it being understood that he would defray all the expenses incurred for the material. The proposal appealed to Dr. Winter immediately and, a suitable gap existing in his workshop programme, he eagerly set to work on this novel construction. The "Silver Rocket" was duly completed as promised and remains a remarkable tribute both to the genius of George Stephenson and to the skill of its modeller. It is truly the work of an artist and a craftsman combined.

A Swiss Mountain Workshop

The model is built to a scale of three-quarters of an inch to the foot, the smallest in which all the fine detail could be satisfactorily included. The engine measures just over 9 in. in overall length and, with its



The "Congreve" clock with travelling-ball escapement. A cause of never-ending wonderment to Dr. Winter's friends.

A Workshop in Switzerland

quaint-looking tender, it stands on a base some 18 in. long. The work was begun in June, 1929, and completed in June, 1932. It is probably the only engineering model ever to be built high among the mountains of Switzerland, for Dr. Winter, having retired from his medical practice, and being an enthusiastic mountaineer, built himself a lovely chalet 2,500 ft. above Sierre, in the Rhone Valley. This home was run entirely by electricity ; there were six electric motors, and services for cooking, refrigerating, lighting and central heating. There was, of course, also a workshop, though at first a good deal of the equipment was installed in the living room of the chalet, so that the Doctor could quietly carry on with his absorbing work in the happy company of his devoted wife. Not a little of his success is due to the sympathetic interest and encouragement he received from Mrs. Winter. To quote just one instance, during the building of the "Como" she held the tender in her arms while he put in the rivets—hundreds of them—until she was ready to drop with fatigue ! Surely a wonderful example of patience and physical endurance and practical interest in her husband's hobby.

Readers may wonder why the "Silver Rocket" was built so much more quickly than the "Como." There were several reasons : (1) The



The lovely view from the workshop window in Dr. Winter's Swiss chalet. What an inspiration to a mountaineer and mechanic !

The Work of Dr. J. Bradbury Winter

original "Rocket" was a much less complicated job than the "Como." (2) Dr. Winter had retired from his medical practice and was able to devote his whole time to the work. (3) Miss Mackworth's help effected an immense saving in time ; the two workers together put in an average of something like eighty hours a week. (4) A much more elaborately-equipped workshop was available for the later model.

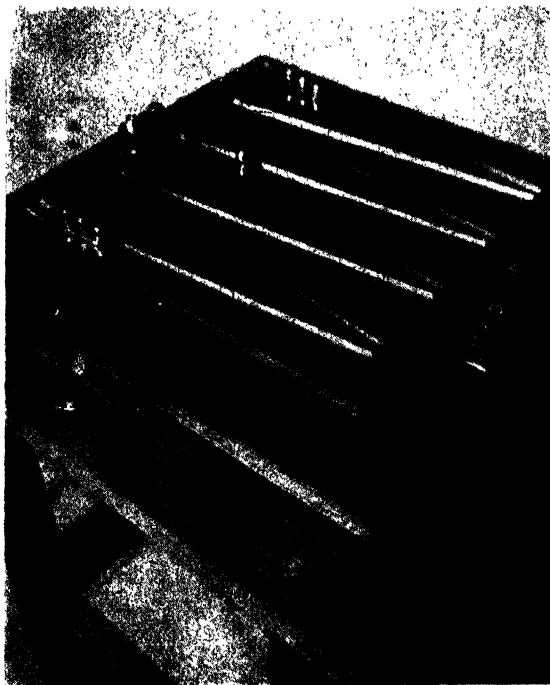
The story of the "Silver Rocket" would not be complete without an acknowledgment of the great interest shown in its progress by Mr. C. N. Goodall, managing director of Robert Stephenson & Co., of Darlington, the builders of the original "Rocket." Not only did Mr. Goodall assist by supplying a complete set of working drawings, sixty large sheets in all, but from time to time when details of the silver model were sent to him for inspection and approval, he took great pleasure in exhibiting them to his workpeople, who were much impressed by their faithful adherence in miniature to the proportions of the prototype.

They were familiar with all details, having quite recently built a full-size replica of the "Rocket" to the order of Mr. Henry Ford, of America.

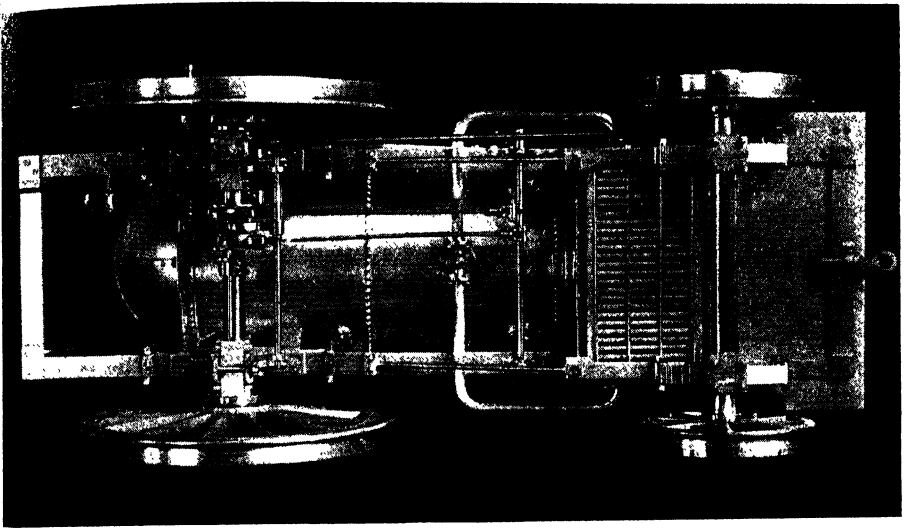
Mr. Pendred was most enthusiastic about the accuracy of the model and the painstaking and meticulous methods adopted in its construction. In March, 1931, he wrote to Dr. Winter :—

"The ingenuity you show in surmounting technical difficulties is on the highest standard of mechanical craftsmanship, and the design of your jigs could not be beaten and rarely equalled by the best tool-room men".

In a later letter Mr. Pendred wrote :—



The travelling-ball escapement of the "Congreve" clock.



An underneath view of the "Silver Rocket" model locomotive.

"The consumption of silver is appalling, but when finished the model will be worth its weight in gold."

Dr. Winter told me that he became so absorbed in the building of this model that he dreaded the time when it should be finished and there would be nothing more he could do to it. As an instance of his patience, I may mention that the firebox contained 165 separate stays. When these were first put in they caused some slight distortion in the external appearance of the firebox. What must he do but take them all out again and replace them with stays which were the last word in accurate fitting.

The Tender of "The Rocket"

The queer-looking tender was not without problems of its own. The framework was of wood having no less than eighty joints, and the water barrel presented some quite new difficulties to this enthusiast. He had never built a barrel before, and discovered that the staves, thirty-six in number, had to be cut and shaped to very precise curves in order to make a water-tight joint. The silver hoops binding the cask also required most careful forming in order to accommodate themselves exactly to the required curves. This barrel is 4 in. long by $2\frac{7}{8}$ in. at the centre diameter. In its way, it is as clever a piece of modelling as the engine itself.

The Work of Dr. J. Bradbury Winter

Later Activities

Having completed the "Rocket," and now too old for serious mountaineering, Dr. Winter returned to England and, setting up a fresh workshop, devoted a good seven hours a day during the next six years to the making of some original and very complicated bits of mechanism for his nephew, Mr. Paul MacEwen. The main principles of these works (combinations of clockwork and electricity) had been in both their minds for some time and frequently discussed. Mr. MacEwen has not only these special "treasures," as he calls them, but has collected a small museum of his uncle's efforts, including the Congreve clock and one of the calendars. He lives at 11, Church Drive, Daybrook, Nottingham, and would, I am sure, be delighted to show these unique specimens to anyone interested.

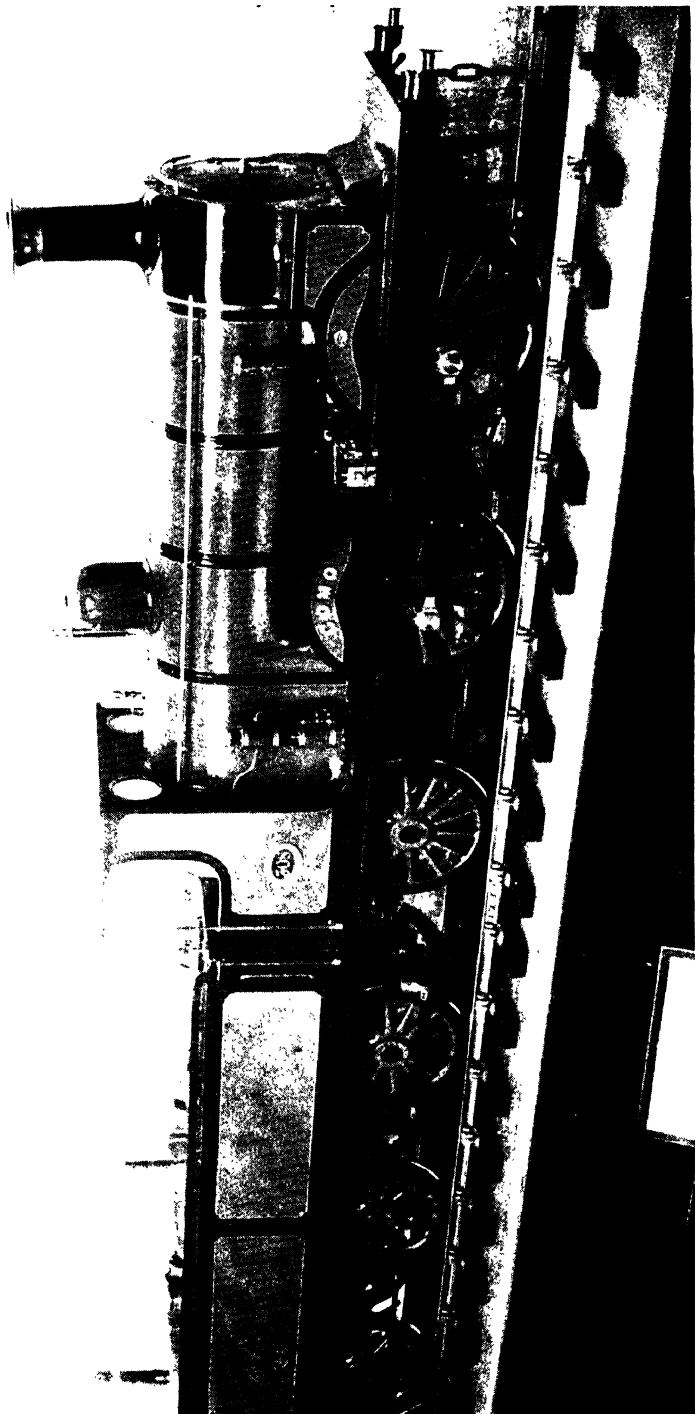
Dr. Winter has told me of his satisfaction in having just completed all that they had planned when rather suddenly failing health and the start of the second World War put an end to his activities. Although he now no longer possesses a workshop, he has retained a few tools, and finds much pleasure in undertaking, for the love of the work, minor clock adjustments and repairs, and executing some of those little odd mechanical jobs which are always brought round to a neighbour who is known to have tools and a knowledge of how to use them.

His Interest in Steam Motor Cars

I have referred to Dr. Winter's second hobby of mountaineering, but he had a third interest, that of steam motor cars. One of the first owners of a steam car in this country, he has always been a sturdy exponent of the virtues of steam power on the road. He does not claim that a steam car is more efficient or more handy than the modern petrol car, but the fascination of a steamer compared with an internal combustion engine is similar to comparing a reciprocating marine engine with a turbine, or to the pleasure of a ride on the footplate of an express locomotive compared with a seat in the driving compartment of an electric train. Since 1900 he has owned no fewer than fifteen steam cars, all Stanleys, and he only sold the last one in 1942 on account of war restrictions.

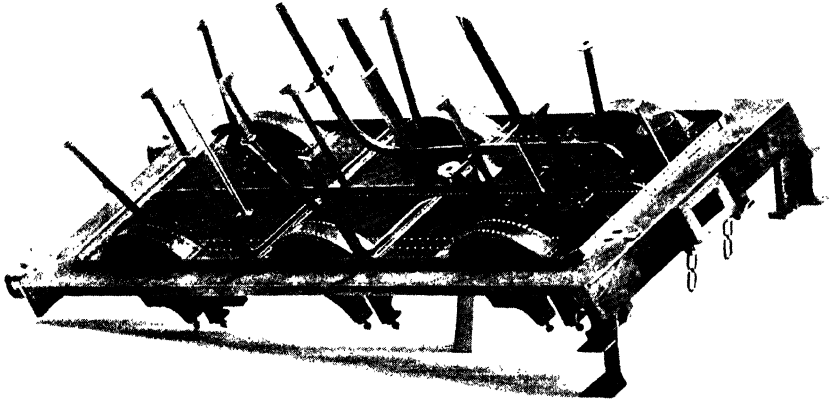
A Life's Achievement

There are many model engineers who have devoted years of patient work to the building of one super-model, but I do not know of any who have repeated such an effort with the patience and success related in this story of one model engineer's life-time hobby. Dr. Winter's craftsmanship is beyond criticism, but when this skill with tools is combined with so



DR. J. BRADBURY WINTER'S MODEL OF THE LONDON, BRIGHTON AND SOUTH COAST RAILWAY CO.'S
LOCOMOTIVE "COMO."

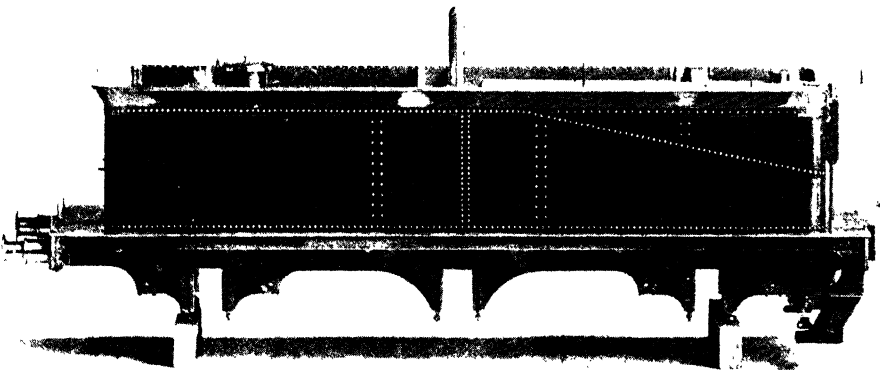
Scale 1 in. to the foot. This model, now in the Museum at Brighton, is generally considered to be one of the most perfect locomotive models in existence. It is absolutely to scale in every detail and represents twenty years of spare time hobby work

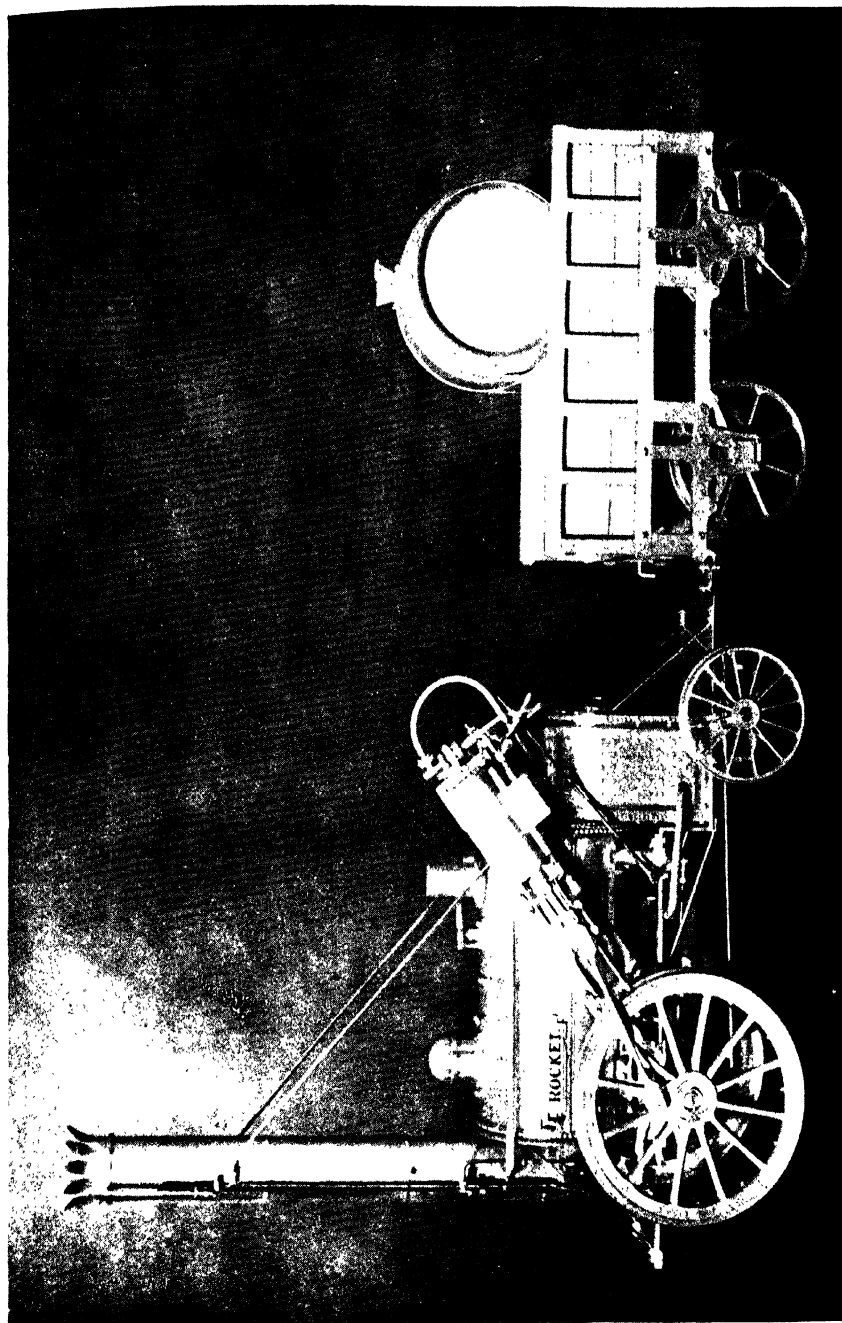


Inside the tank of the "Como" tender before putting on the side plates. The details are conscientiously made to satisfy the builder, although they are not seen in the model, and this photograph is the only evidence of their existence

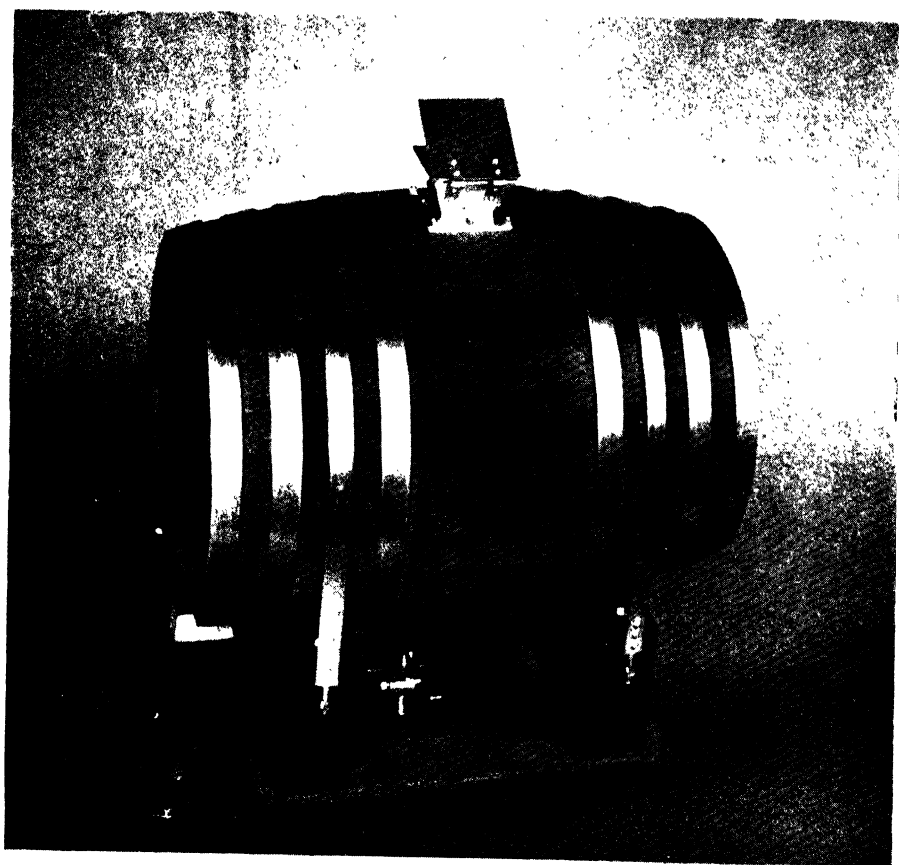
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Side view of the "Como" tender before the clothing plates were put on





Dr. J. Bradbury Winter's model of the famous "Rocket" locomotive, complete with tender. The model was built for presentation to the Institution of Mechanical Engineers. The engine is mainly of silver



A very unusual job for the model engineer. It is the water-barrel carried in the tender of the "Rocket" locomotive. It has thirty-six wooden staves held together solely by the silver hoops. Made by Dr. J. Bradbury Winter for his "Silver Rocket" presentation model

A Life's Achievement

much unflagging enthusiasm and industry and with such a brilliant talent for invention, we can understand how much is the admiration felt for him among model makers wherever his work is known. To the word admiration I would add affection, for how can we help but esteem a man so modest about his own achievements, so interested in other people's endeavour, and so willing at all times to give practical help and advice from his vast experience and exceptional engineering ability. The model engineering world owes Dr. Bradbury Winter a profound debt of gratitude for setting such a high standard of endeavour and achievement.

[As intended, the "Silver Rocket" is now in the library of the Institution of Mechanical Engineers. Anyone wishing to see it and mentioning Dr. Winter's name is cordially welcomed. The Institution is at Storey's Gate, St. James's Park, London, S.W.1. The "Como" has been given to the Brighton Corporation, and can be seen at the Free Library and Museum at the bottom of Church Street, Brighton.]

V

SMALL-GAUGE MODEL RAILWAYS

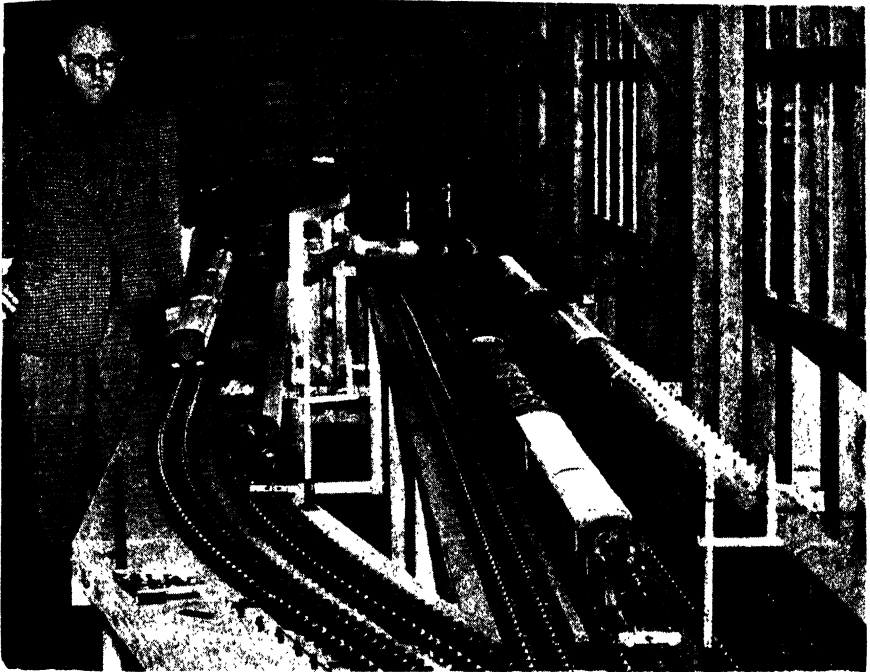
For Indoor and Outdoor Tracks

EVER since the days of the success of George Stephenson's famous locomotive, the "Rocket," at the Rainhill trials in 1829, railways have been a constant source of public interest, both to young and old. Not only have they conferred untold benefits on the community for personal travel and the dispatch of goods in the home country, but all over the world they have linked cities and towns and countries together, and have led to the opening-up and development of vast areas of hitherto uninhabited space. Small wonder, then, that the "iron horse," in its many manifestations, has aroused interest and admiration in the minds not only of the younger generation, but of its more serious and reflective elders. One reason, no doubt, for the popularity of the railway both as a toy and as a subject for the serious study of model engineers is the fact that it is such a familiar object of daily life. We all see the railway and travel by it, and we are all impressed by the power and speed of the locomotive and by the many intricate requirements and constructions of permanent way, signals, stations and bridges. For the past hundred years or so every small boy has at some time had the fixed intention of becoming an engine driver in later life, and to play with a model railway which actually worked has given him endless hours of delight. The present generation may be thinking more in terms of motoring or of flying, but even so it will be many years before the railway loses its grip on the child's enquiring mind.

Some Early Model Railways

For a very long period model railways and model locomotives remained in the province of the toy maker. Even a model railway operated by a clockwork locomotive was regarded as merely a luxury toy, and a single engine with a few coaches and a short length of tinplate permanent way represented the acme of achievement in catering for entertainment of the

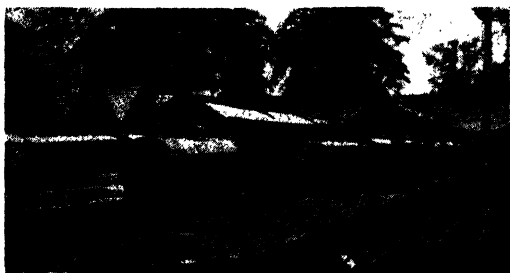
A Distinguished Model Railway Engineer



The Earl of Northesk, Past-President of the Society of Model and Experimental Engineers, with his indoor model railway.

juvenile railway enthusiast. Then the toy trade discovered that there was a greater fascination in a model locomotive which actually worked by steam, and a range of low-priced steam models came on the market to the delight of the younger folk. These were mostly of an extremely simple character and resembled a locomotive mainly because they had a boiler, a funnel, a cylinder, and some wheels. The steam was generated by heat from a methylated-spirit lamp under the boiler, and the model rejoiced in an inspiring name, such as "Ajax," "Vulcan," or "Fury." These models worked in so far as they would get up steam, the wheels would revolve, and the engine would hiss and splutter its way along a very limited track or round a circle of modest diameter. Concurrently with these cheaper productions more elaborate and expensive designs were brought out and sold, principally through the shops of optical and scientific dealers. They purported to represent some of the crack locomotives on the fast-developing real railways, and were an advance on the "Ajax" type, since they included slide-valve instead of oscillating

Small Gauge Railways



Realism in railway modelling—how like the real thing

cylinders, the method of firing was improved, and some of them even sported a reversing gear. The prices ranged from £5 to £20, and for the time being they satisfied the desires of an older and wealthier class of purchaser. A few of them are still in existence and are interesting memorials

of a period when the attraction of a working model railway began to be felt, but before the hobby assumed its present degree of technical exactitude. Here and there a firm taking a more serious view of model engineering produced engines which were not only reasonably accurate representations of real locomotive practice, but gave a far more satisfactory working performance when put under steam. These engines more often than not were built to suit the requirements of special customers who had definite views as to the type of model they wanted. Among these firms, H. J. Wood, of Oxford Street, was well known for the realistic appearance and fine workmanship of his models, and Lucas and Davies, Bedford and Co., and Hurst and Lloyd were also in the front rank as model makers. Mr. Wood was the father of the late Sir Henry J. Wood, the famous musical conductor. But despite these able exponents of the craft, the well-designed model locomotive was a rarity in the shop window, rather than the reverse.

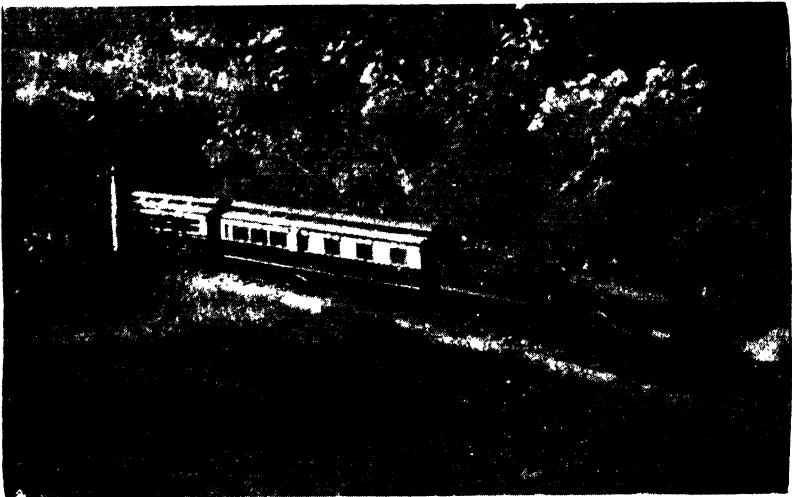
The Dawn of Realistic Modelling

The general change-over to realism began when *The Model Engineer* took up the guidance of its readers in the principles of engineering design, and illustrated examples both of good types of real locomotives and of reproductions in miniature which combined accuracy of detail with good working qualities. From that time a model-making trade, as distinct from a toy-making trade, began to grow, and I am glad to pay a tribute to the enterprise of Bassett-Lowke Ltd. as the leading pioneers in this field. Other firms of model railway manufacturers and suppliers have since come into being, and nowadays every possible requirement of the model railway builder is amply catered for. The development of the hobby has been materially assisted by the publication of a special journal *The Model Railway News*, which, while devoting itself mainly to the

The Work of Henry Greenly

construction and operation of miniature railways, gives its readers drawings and photographs and news of notable real railway prototypes for their emulation and interest. This journal, now under the able editorship of Mr. J. N. Maskelyne, was an offspring from *The Model Engineer*. So rapidly did model railways grow in favour that the parent journal could not find space for an adequate treatment of the subject, and a companion journal was produced, with immediate success. The story of the early days of this branch of the model engineering hobby would not be complete without acknowledgment of the work of the late Mr. Henry Greenly as a writer and designer for model railway constructors. Through books, articles and blue-prints he provided the model world with a continuous flow of practical information which helped thousands of enthusiasts on the road to success. His fertile brain evolved an unending series of designs for locomotives and railways from the smallest miniature layout to the commercial passenger-traffic railways of Ravenglass and Eskdale in Cumberland and of Romney-Hythe and Dymchurch in Kent.

The model railway hobby differs from model engineering in its stricter sense, since so much of the equipment and material required is usually purchased ready-made from trade sources. Although some model enthusiasts are skilful enough and painstaking enough to build their own engines and rolling stock, many are content to buy the excellent equipment available from the supply houses. They find their pleasure primarily



Emerging from the tunnel—here she comes!

Small Gauge Railways

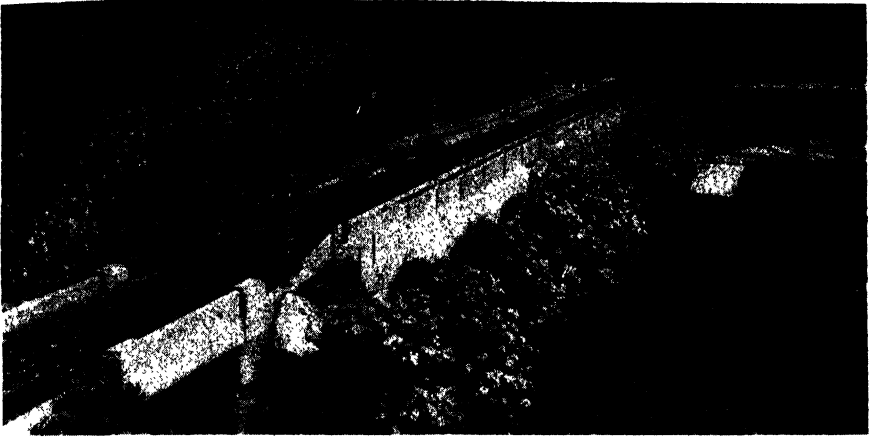
in the installation of the railway, but mainly in its operation in accordance with real railway practice.

Electric Model Railways

The factor which has had the greatest influence in the development of indoor model railways has undoubtedly been the use of electricity as the motive power. It is true that clockwork mechanisms are still in demand for railways of the toy variety, and that excellent realistic clockwork models are also available for those more ambitious layouts which are not too extensive in character, or for which an electrical supply is not available, but electricity has played an enormous part in expanding the scope of model railway operation and control. It results in one rather remarkable anomaly, in that most indoor model railways use engines and rolling stock representing real steam railways in all particulars except in the one respect that they do not work by steam but by electricity. Electric operation possesses several advantages over steam for indoor railways chief among which are its cleanliness, the absence of the constant attention necessary for the regulation of fuel, oil and water, and the ease with which the running of the trains can be controlled from one central switchboard. The steam-outline engine, however, retains its popularity even when electrically driven, in preference to the different and less picturesque design of the locomotives used on the real electrified lines. The lack of realism in the absence of smoke and steam is compensated for by the other advantages I have mentioned and the love of the owner for engines and coaches of a particular line can be given full play. So long as steam locomotives are in general use on real railways, so long will they be popular as prototypes on the model layout. True-to-type electric trains are occasionally modelled, and even if they lack the artistic appearance and imaginative interest of the steam train they are most efficient from an operative point of view. Steam is still the motive power for most outdoor railways in the larger gauges, particularly where passenger-hauling is one of the attractions. But steam and smoke and oil are not objectionable out of doors, and the real engineering flavour of these essentials is often regarded as an additional source of interest. Moreover, electric railways in the open air are apt to suffer from inclement weather conditions.

Laying Out a Model Railway

When the layout of a model railway extends beyond a simple set of rails with perhaps a station and a siding, a bridge, and some signals it ceases to be a toy. The joy of running trains aimlessly round a circle, or



An effective model railway in the garden—truly a flower among the flowers.

to and fro on a limited length of track may suffice the juvenile mind, but it would soon pall on the adult looking for a worthwhile hobby. He approaches the subject from a very different standpoint. He has in mind a real railway in miniature giving the same service to an imaginary public and faced with the same problems of permanent way, terminals, sidings, train marshalling, signalling, and safety of running. His railway begins to become a study, a pleasant and absorbing study, requiring intelligent consideration not only of real railway practice, but of the most effective and realistic way of reproducing it on a miniature scale. In fact, it has become a real recreation of a very instructive kind, giving that agreeable relaxation from the problems of daily life which is the fundamental object of every hobby. If the owner is skilled with his hands he may derive much enjoyable occupation from the building of the engines and rolling stock and the many scenic accessories to a representative layout. The electrification of the line is an interest in itself, and there is room for ample thought and ingenuity in the signalling and planning of the services to be run. It has been truly said of a model railway that it is always complete but never finished. There are always some extensions or additions to be carried out, some new equipment to be bought or made, or some development in the running of the services to add to its interest. It is a hobby which offers great scope for artistic ability in the painting of scenic settings and the modelling of lineside buildings and accessories.

With most hobbyists the question is not merely one of installing and operating a working model railway. The conception and planning of the

Small Gauge Railways



**The Harbour and Customs office on Mr. J. H. Ahern's model railway.
Note the waiting taxi.**

railway usually have some relation to a real locality or to the requirement of an imaginary but definite public. I know of one prominent enthusiast who has an extensive layout in the basement of his house. He says, "I visualise my model railway as serving the requirements of an imaginary country, of which I am the Minister for Railways. The country has certain agricultural and industrial interests for which suitable transport must be provided from the farm or the factory to the city or the docks. Where necessary, special freight wagons must be employed to accommodate the machinery or merchandise to be carried. The passenger requirements, including holiday excursions, are so and so, and suitable trains stations and terminals must be provided to enable this traffic to be handled." This model railway fully lives up to the imagination of its owner, and to see it in operation makes one realise immediately the fascination of miniature railway work when followed on such a carefully thought-out plan. This particular owner, having considerable knowledge of real railway practice, designs his own locomotives to suit the requirements of his imaginary country and has many of them specially built by a professional model maker. In design and technical detail they are most impressive and satisfying to the engineering eye.

I know another enthusiast, a retired army officer, who has built a model railway which gives a particularly realistic rendering of the Southern Railway line between London and Dover. This is erected in an outbuilding in his garden, where, by laying portions of the track at

A London to Dover Model

different levels, he is enabled to obtain a continuous run for his trains over a distance having an approximate relation in scale to the real railway. At one end of the track is an excellent model of Victoria Station, and at the other is Dover Harbour, with a cross-channel steamer alongside the pier waiting to receive the passengers.

Many railway modellers choose some existing local railway or branch line on which to plan their layout. The engines and rolling stock are all true to type and the addition of easily-recognised local scenery and buildings makes the model a perfect miniature of the real thing. The limited length of the local line enables the operation and setting to be reproduced to scale very faithfully. One of the most compact model railways I have seen was built into a suit-case, so that the owner could carry it round to the homes of his friends, and they could mutually enjoy the pleasure of working it. It represented a terminal station with adjoining goods sidings. Operated electrically, the train could be made up in the sidings, coupling-up being automatic, and run in and out of the station as the service required. All the points and crossings were laid out with great accuracy, and from a single switchboard a great variety of operations could be controlled.

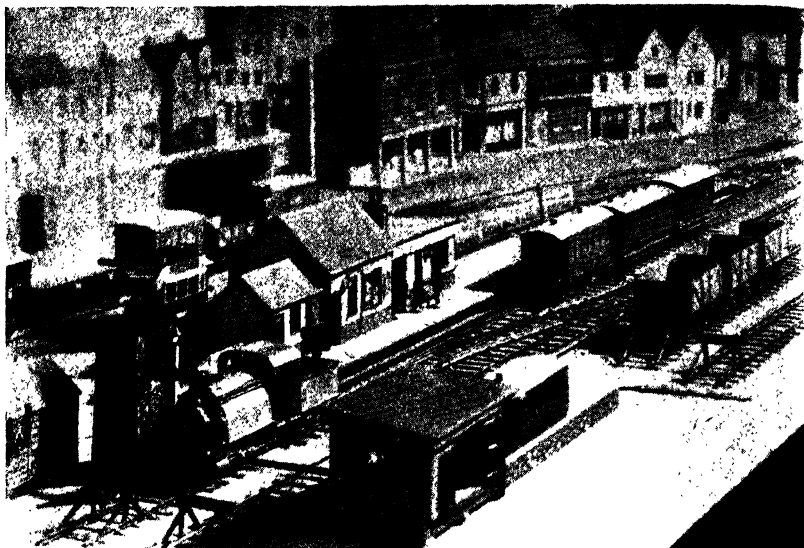
Choosing a Suitable Gauge

The layout and erection of an indoor railway is very largely governed by the availability of space. The toy railway can be set out and packed



Some more of Mr. J. H. Ahern's clever architectural modelling. The figures and the motor car show how well the scale is preserved.

Small Gauge Railways



The lineside buildings add much to the realism of this model terminus.

away without any difficulty, but the true model railway requires a permanent location, preferably quite free from any domestic interruption. If of a very small gauge, it may be laid out on a floor or a large table, but the larger gauges are best installed on a bench running round the room and of such dimensions as to provide for the desired multiplicity of tracks and curves of sufficient radius to accommodate the rolling stock employed. An important point is to install the layout at such a height that it can be conveniently operated without undue stooping down to make the various connections and adjustments. A height of about 3 ft. 6 in. will be found to give a comfortable operating level. If a continuous track round a room is desired, provision must be made for entrance through the door and for access to a central position for the operator. The intending hobbyist should give careful thought to the space available for his layout and decide whether he will budget for a continuous track or for one which runs to and fro between terminals. His decision will be largely affected by the gauge he proposes to adopt, since in the very small gauges a continuous layout can be arranged on a separate bench or table.

The gauges which are in general use for indoor operation, and for which trade supplies are available in great variety, range from "OO" to "1." The "OO" gauge in its original form had a width of $\frac{5}{8}$ in. between the rails, but it was found in practice that some departure in

A Famous Lady Enthusiast

exact scale for the locomotives and rolling stock was desirable, in order to permit more robust and perfect modelling of the details, and to give less trouble in the track layout and the operation of the trains. The subject has recently been under consideration by the Model Railway Standards Bureau, a body of experts formed for the purpose of specifying definite standard dimensions to ensure satisfactory working in all scales. They have recommended a choice between the following alternatives : "HO," with a gauge of 16 mm. and rolling stock to the scale of $3\frac{1}{2}$ mm. ; standard "OO" and scale "OO," the former with a gauge of $16\frac{1}{2}$ mm., the latter with 18 mm., but both to an approximate scale of 4 mm. It is anticipated that the standard "OO" dimensions will prove to be the most popular for these miniature layouts, but its general adoption will depend on the experience gained in actual practice. It is perhaps unfortunate that this difference of opinion as to the best gauge and scale should exist, but it must be remembered that these very small gauges are a



The model railway fascinates the fair sex. Here is Miss Jean Forbes Robertson, the famous actress, with the model railway which she delights to operate in her off-stage hours.

Small Gauge Railways

product of recent years and that a final standardisation of supplies and constructive practice must be evolved by the results of working experience.

The next larger size is known as gauge "O," and for those who have the space available this has proved by far the most popular gauge. It has a width of 32 mm. (approximately $1\frac{1}{4}$ in.) between the rails. It enables most realistic engines and rolling stock, with robust details, to be produced, and there is a multiplicity of equipment and accessories available from the trade. It offers a choice between clockwork and electricity for propulsion, but steam, although successful steaming models have been built in this scale, is not regarded as suitable for general adoption.

A still larger size, known as gauge "1," is favoured by some owners, particularly by those who are keen on operation by steam, but it requires considerable space for a layout. It has the advantage of permitting greater realism in detail, and either clockwork or electric power can be applied if desired ; but in view of the limited demand for this size, there

is a much more restricted range of designs and accessories available from the trade. The distance between rails is 45 mm. Some years ago a gauge "2" existed, having 2 in. between the rails, but the demand for this size is now non-existent. The next larger gauge, sometimes termed gauge "3," is more familiarly known as $\frac{1}{2}$ -in. scale, and takes us into the realm of real steam locomotive building, which is a very popular branch of model engineering and is dealt with at length in a separate chapter.



An elaborate out-door layout. Note the signalling and the tunnel leading to the engine shed.

Some Considerations in Planning

When the hobbyist has decided on the gauge he is going to adopt, he can begin the fascinating task of planning his model railway. If he chooses

Planning a Model Railway



Prince Bira of Siam is a keen model railway enthusiast. He is seen here, with Mr. W. J. Bassett-Lowke, at the control board of his extensive indoor lay-out, in "OO" gauge.

to reproduce a portion of an existing real railway or a model of a complete branch line or local railway, the general layout of the line will already be determined for him by the actual system he is copying ; but if he prefers to be original and plan a system of his own he will have ample scope for thought as to the best way of utilising the space at his disposal and of providing for the various services he wishes to run. He should, if possible, study some published plans, or a handbook on the subject, so that he may profit by the experience of others and get some practical ideas with regard to points and crossings, loop lines and sidings, turntables, and the location of stations and bridges or tunnels. The making-up or marshalling of trains in sidings or goods-yards, the shunting of engines and coaches in and out of terminal stations, and the use of turntables, are all operational matters of great interest, and in planning a layout these points must be taken into account. Similarly, the length of station platforms, the radii of curves and loops, and the lengths of siding tracks must be in correct relation to the scale of the trains to be run.

The Development of a Model Railway

Having planned the railway and provided a suitable bench or table, the work of construction may begin with putting down the permanent

Small Gauge Railways



A country station in miniature. Very effective use is made of model passengers, notice boards, luggage, and the station clock. There is even the ubiquitous dog!

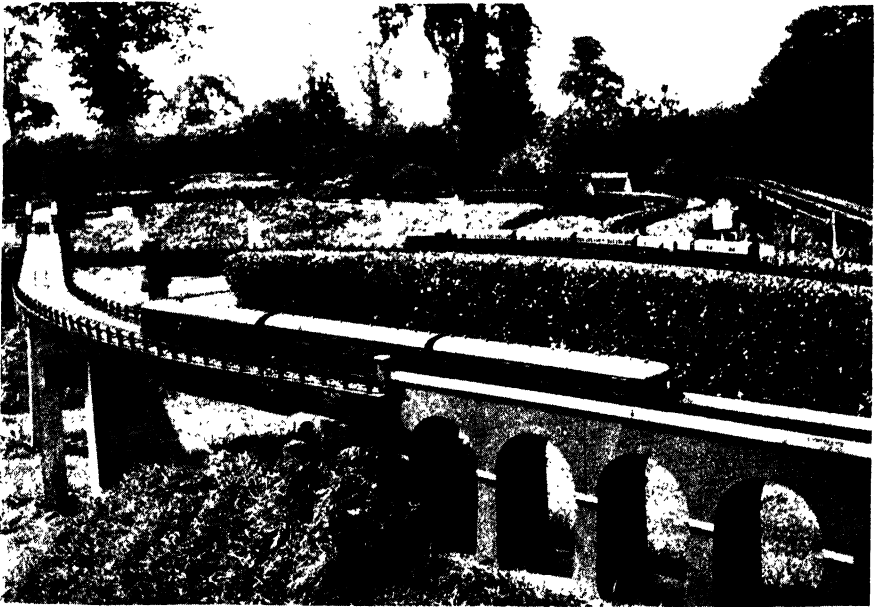
way. If good running is to be ensured, the track must be very accurately laid. It is almost certain that, once the railway has been put into operation, improvements and extensions will suggest themselves to the owner. He should, therefore, start by laying the main-line portion of his track and putting it into operating condition. He can then get some experience in train running and a clearer conception of where his branch or loop lines and sidings could be placed to the best advantage. To lay down a complete system and then find that it was not practical in operation would mean the altering, and perhaps the uprooting of a lot of patient work. A model railway grows automatically in a sense, inasmuch as the owner is constantly finding out by imagination and by experience how it can be developed and improved. It is, in fact, a never-ending source of interest, and it is better that it should begin to function in a comparatively simple form, with extra features being introduced as and when required. A model factory or coal mine may be added as a line-side feature. This will call for a goods siding into the factory or colliery yard. Passenger traffic may develop so that more trains need to be run and to be accommodated at the terminal platforms on more than one track. A dock or riverside terminal may be required with cranes for unloading. Steamers or barges will give the owner another outlet for his modelling skill. A new bridge may be needed to span a wider track, or a tunnel may be necessary to enable some hillside scenery to be added at a particular spot. All these developments will need an elaboration of the signalling of the line if real practice is to be followed, and will add to the niceties of the electrification. There is still to be considered the scenic setting and

Railways in the Garden

background of the railway which, if artistically carried out, can add so much to the realism of the layout and provide such an interesting variety of work to be done. Some model railways are as interesting by reason of their surroundings as by the actual running of the trains. An example of this is the well-known Bekonscot Model Railway, at Beaconsfield, referred to in a later chapter, which is laid down in a complete model village, where the houses and the trees and the church are all most perfectly reproduced in miniature, and the railway adds life to the entrancing scene.

Garden Model Railways

Although the majority of small-scale model railways are for indoor entertainment, there are a number installed in gardens, especially where steam is the motive power employed. One of the most elaborate and interesting of these is the property of Mr. Victor B. Harrison, of Bishop's Stortford. He chose the "1" gauge, being a steam enthusiast, and has put down a most effective and entertaining layout, which adds materially to the interest of his garden without in any way detracting from its scenic beauties. Although most of the track is in the open, Mr. Harrison wisely



Mr. Victor B. Harrison's garden railway at his house at Bishop's Stortford. It is in "1" gauge and is operated by steam locomotives.

Small Gauge Railways



A cross-over bridge on Mr. Harrison's railway.

planned to have his principal station under cover. This not only enables him to have a sheltered spot for steam-raising or for carrying out any needful adjustments or repairs, but it affords an agreeable place of resort when the weather precludes the operation of the trains outside. Mr. Harrison is a confirmed experimentalist, and has spent many enjoyable hours in adapting the details of his engines and carrying out exhaustive trials to test

their steam-raising qualities and their performances on the track. He has originated many improvements in model steam locomotive design and operation, from which the hobby generally has greatly benefited. He has two other hobbies—model shipbuilding and real yacht cruising. Of his achievements in the former of these interests, I shall have something to say in a later chapter.

The Model Railway as a Business Tonic

Apart from his hobbies, Mr. Harrison is a much-occupied business man and, knowing his many-sided activities, I asked him in what way he found his model railway and model shipbuilding interests of benefit. This is what he said :—

“However busy a man may be, I think it is most essential for him to have a hobby of some kind. The problems of a hobby or its fascination take his mind off daily worries. I personally have found my hobbies a pick-me-up. A doctor once said to me that it was good for a man to get absorbed in his hobbies, as it gives his business brain a rest and he made use of another portion of his brain. When I am working on my locomotives



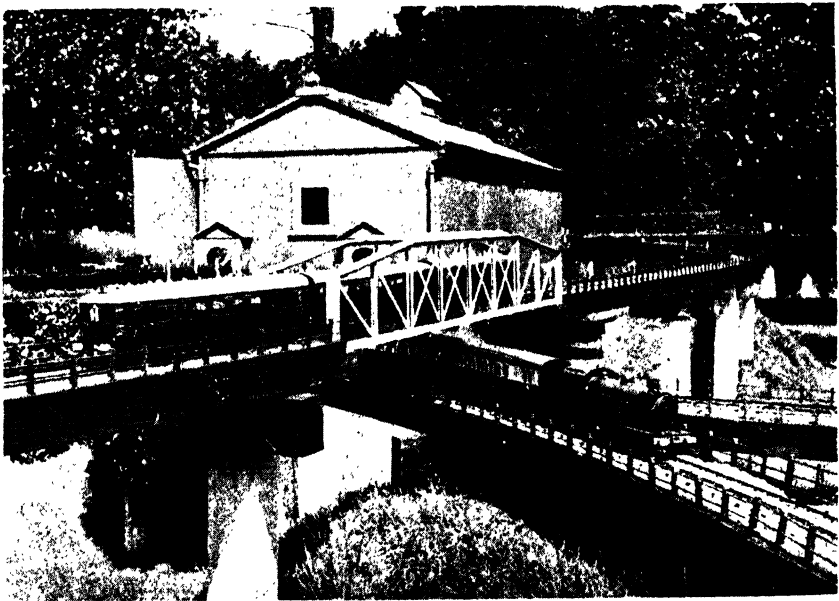
A miniature station and signal-box at Bishop's Stortford.

The Question of Cost

or railway I become, for the time being, a railway engineer, and when building model ships I am a shipbuilder. When I am yachting, besides becoming for the time being a seaman, I have the additional advantage of being in the fresh air. Another reason why a man should have a hobby is that, when he has to retire from business, he still has a definite object with which to occupy his time. One so often hears of a man retiring from an active business life who lives only a few years after retirement and, in some cases, only a few months. On the other hand, the man with a hobby seems to be busier than ever and to be enjoying himself thoroughly."

The Cost of Model Railways

The prospective model railroader may ask whether the hobby is likely to be a costly one—will it be within his means? His mind need not be perturbed by the pictures of the rather elaborate layouts with which this chapter is illustrated. He must remember that in most cases these model railroads started in a comparatively simple way. They grew by degrees, just as his own railway will do, and he can make the hobby as economical or as expensive as he wishes. If he is useful with his hands he can make a great deal of the equipment for himself, either from raw material or from



How Mr. Harrison has surmounted some of his permanent way problems. An excellent example of model civil engineering construction.

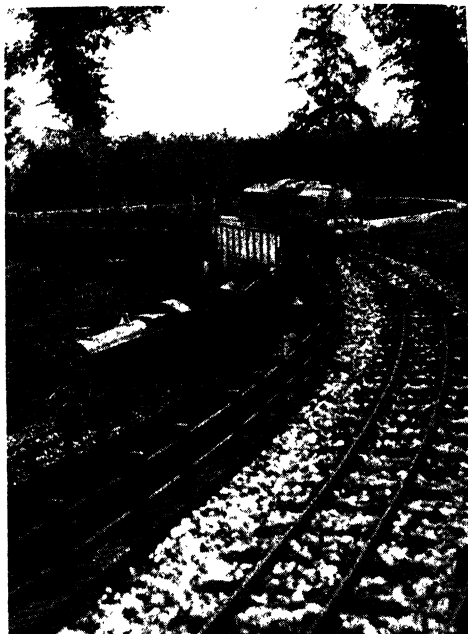
Small Gauge Railways

purchased sets of parts. If cost is a real consideration he will find an ample choice of well-designed and well - made locomotives, rolling stock and accessories on the market at very moderate prices. Should his pocket permit, and his tastes be very exacting, he can obtain beautifully-made super-detail engines and coaches which will satisfy the most meticulous critic. He can start a very high-grade layout in a simple way, adding to it at intervals when funds permit, and deriving much pleasure from seeing his railway grow. In fact, he can make his hobby a "pay-as-you-go" affair, but all the time he should have in mind a well-thought-out scheme for his railway so that his purchases or his home-made additions will

all be in keeping with the main idea. As he meets other enthusiasts, or reads about their models and their doings, so will his understanding of the real purpose and pleasures of the hobby increase.

Some Notable Hobbyists

The model railway hobby has many notable followers among whom may be mentioned The Earl of Northesk, Prince Bira of Siam, Sir Malcolm Campbell, Sir Francis Layland Barratt, Bart., and Miss Jean Forbes Robertson. There are few hobbies which offer such a variety of technical interest, or such scope for handicraft or artistic ability in many directions. One may look at a well-constructed model railway and marvel at the exactitude with which it presents the features of a real railway. Indeed, some model layouts follow real practice so accurately in scale and in perfection of detail that, when looking at a photograph of the model, one can hardly believe that it does not represent a scene on a full-size railway. Then, when the owner touches a switch, the model becomes alive. The "Flying Scotsman" coaches are made up in the sidings, the engine is coupled on, the train is backed into the departure



Rounding a curve at Bishop's Stortford. Note the realistic ballasting of the track.

The Railway is a Live Thing

platform of the terminal, the signal gives the “right-away,” and the train moves off to its allotted destination. This is but a simple example of the many operations of the model railway. The combinations of shunting, switching, signalling, interlocking, branch-line working, and through-running are endless, and provide entertainment for hours on end to the owner and his friends. Truly, it is a fascinating hobby.

VI

STEAM LOCOMOTIVE BUILDING

Scale Models and Small Power Engines for Passenger-carrying Tracks

THE appeal of the steam locomotive to model engineers makes itself felt in various ways. I have already dealt with the fascination of the model railway in which the working model locomotive plays such a prominent and attractive part, even though it be an electrically-driven engine charmingly masquerading as a miniature of its steam prototype. But many model engineers aim at construction on a larger scale and build non-working models of favourite types of locomotives to be preserved as glass-case portraits of the creations of famous locomotive engineers. Others who have a different end in view design and construct working steam locomotives intended for actual service on garden or estate passenger-carrying tracks. This type of engine is often only a model in the popular use of the term to denote something of diminutive size. While it is true that many of the popular engines on real railways are modelled for working purposes, there are numerous other very successful small-power locomotives which are as much examples of original design as are their full-sized brothers. More of these anon ; for the moment I want to say something about the glass-case type of model. ■

The Appeal of the Locomotive

The steam locomotive as such has a particular appeal to the constructor because, in the first place, it is a self-contained working unit. It is a thing of life and power, complete in the generation of its own steam pressure and the conversion of that pressure into motion on the track. But beyond this basic appeal, it offers scope for the intelligent investigation of the functions of its various working parts, and for the exercise of patient and accurate craftsmanship in its construction. Moreover, there is exceptional variety in the character of the mechanical work involved in its building. It calls for sheet-metal working, riveting, soldering and brazing, tube and pipe fitting, drilling and tapping, and fine machining and bench fitting ;

Choice of a Prototype

it needs skill in the working of sheet-steel or copper, and of cast iron, gunmetal and brass. In fact, the builder of a good model locomotive may regard himself as an all-round mechanic of no mean order. This variety of work is an attraction in itself, since it gives a constant change of interest in the tools and materials used. There is yet another reason for the appeal of the locomotive to the amateur engineer. It is that he may be, and often is, an ardent admirer of a particular locomotive, or class of locomotives, which he has seen at work on the real railway, or which, in studying railway history, has aroused his interest by the beauty of its design or its significance as a milestone on the road of railway progress. Many model engineers look with loving eyes on pictures of some of the notable engines of the past and determine to re-create them in miniature form.

The Vast Range of Prototypes

Railway transport, as it developed through the years, led to the production of literally hundreds of different types and classes of locomotives, and so the model maker's choice of prototypes became a very wide one. Yet, a study of the subject reveals that, since about 1870, or a little later, certain designs of locomotive have achieved more popularity than others ; and it is interesting to note those types which appealed to large numbers of model makers rather than to isolated individuals.



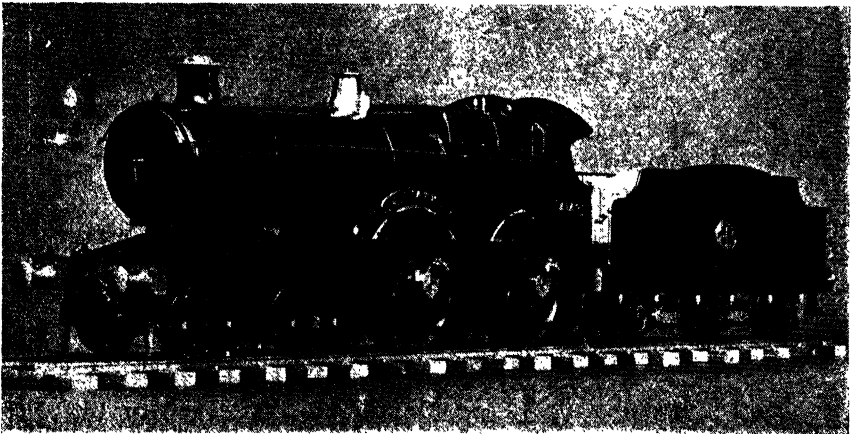
A 3½-in. gauge 4-6-2 engine built by Mr. C. E. Taylor. Has run 550 actual miles and hauled over 100,000 passengers.

Steam Locomotive Models

There can be no doubt that Patrick Stirling's 8-ft. single-wheelers for the Great Northern Railway—a type which was introduced in 1870—enjoyed the widest popularity for a period of something like forty years. In fact, miniature replicas of this particular class of express passenger locomotive are still being built to-day, indicating that there was something about Stirling's design which was fascinating in the extreme. The great driving-wheel ; the graceful curve in the running-plate where it rose to a height that enabled it to clear the revolving big-end ; the massive outside connecting-rod ; the long, straight line of the top of the domeless boiler ; the shapely, bright brass safety-valve casing ; and, above all, the extreme—almost severe—simplicity of the design as a whole, all combined to produce an impression of speed and power which captured the fancy of locomotive enthusiasts all over the world. No wonder, then, that models of these very celebrated locomotives could be counted in many hundreds.

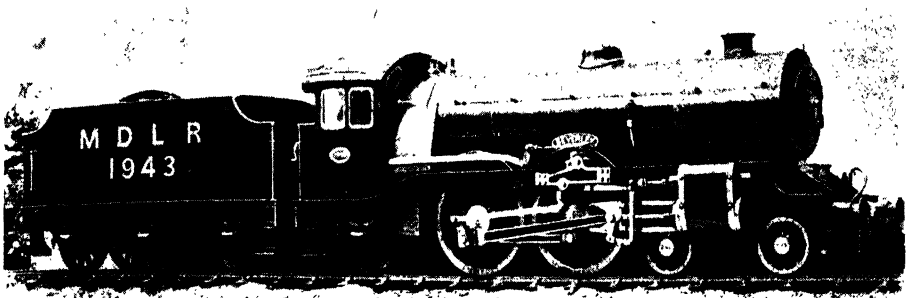
Mr. Stirling's inside-cylinder 2-2-2-type single-wheelers have also been very popular, in spite of the somewhat greater constructional difficulties arising out of the fact that the whole of the driving mechanism was between the main frames. But there were many other types of locomotives to which this remark applies ; the fact is that the skilled model maker does not allow difficulties of the kind mentioned to deter him in producing small reproductions of his favourite prototypes.

The list of popular locomotives could be considerably extended, and a large variety of reasons could be suggested to account for their popularity.



**A model G.W.R. 4-4-0 locomotive, 3½-in. gauge, built by Mr. A.W. Tucker.
The work of 948 spare-time hours.**

Notable Locomotive Engineers



The Atlantic-type 3½-in. gauge model "Beverley" built by Mr. R. C. Marshall. Has run over 250 miles and will haul from 12 to 14 passengers.

Perhaps it might be more correct to state that the productions of individual locomotive engineers have been, and still are, the prime source of the fascination. Famous engineers whose locomotives have strongly influenced amateur craftsmen are : Sir Daniel Gooch, William Dean, George Jackson Churchward, and Charles Collett of the Great Western Railway ; Patrick Stirling and Harry Ivatt of the Great Northern Railway ; Wilson Worsdell of the North-Eastern Railway ; Samuel Johnson of the Midland Railway ; William Stroudley of the London Brighton & South Coast Railway ; John Ramsbottom and Francis Webb of the London & North-Western Railway ; James McIntosh of the Caledonian Railway ; and William Adams of the London & South-Western Railway. These were great names in the railway world of the pre-grouping era and their records extend back through the Edwardian into the Victorian periods. During those years the locomotive reached a perfection of outline and appearance which has been unequalled before or since.

This tradition has fortunately been very well maintained in more modern times, in spite of the fact that the quest for greater power, economy and reliability in locomotives has been attained by some sacrifice of the former "good looks." The modern generation of model makers has not been slow in responding to the appeal of the various designs produced by such eminent engineers as Sir Nigel Gresley, of the London & North-Eastern Railway ; Sir William Stanier, of the London Midland & Scottish Railway ; and Robert Maunsell, of the Southern Railway. Yet, even to-day, there are many who admit a preference for the locomotives which were existing at about the time of the meeting of the last and present centuries.

Steam Locomotive Models



Two visitors from America take a trip on Mr. J. C. Crebbin's garden track.

The Effect of Colour

One point about a glass-case model of a famous locomotive which adds to the pleasure of the beholder is the colour it is painted. In pre-grouping days the locomotives of every railway company were distinguished by a special "livery" of colour enhanced by effective lining-out and the company's coat-of-arms. These colour schemes were selected with a nice appreciation of artistic effect, and the shades of red, green, blue or yellow adopted by different companies added considerably to the general effect of the good technical design. The old Brighton Company went so far as to inscribe inside the cab the name of the driver who was destined

to take charge of the engine on the road. In the famous "Como" model described in an earlier chapter there is a pleasing touch of perfection in the inscription in the cab of the words "John Winter. Driver." It is not too much to say that the painting of a show-case model locomotive, or, indeed, of any model intended for permanent display, is just as important



The L.M.S. "Royal Fusilier," built by Mr. W. H. Brittain, 3½-in. gauge, 80 lb. working pressure, ten years' work.



Mr. T. B. Glover's model "Maisie"—the centre of admiration.

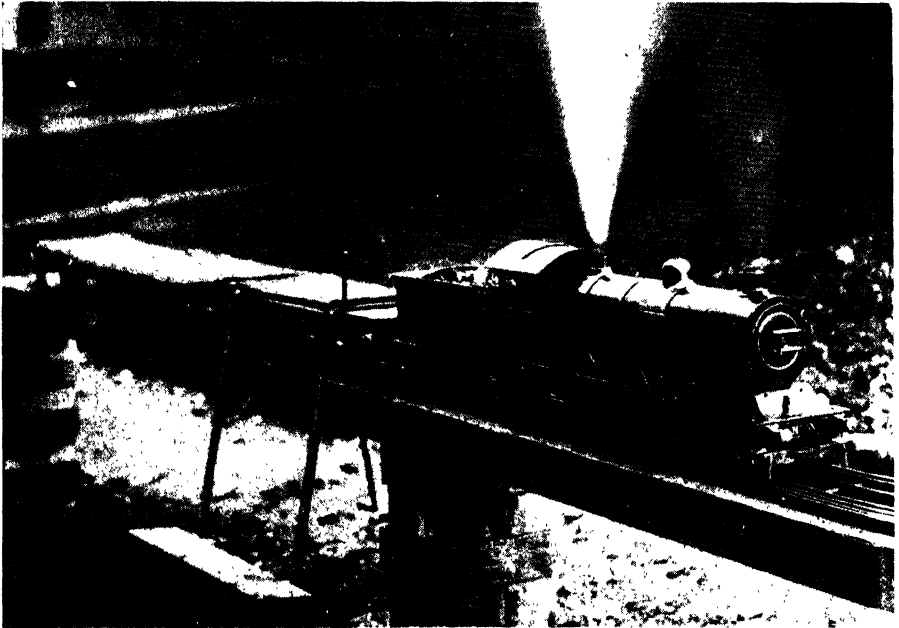
as good mechanical work in its construction, and requires as much patient care and neatness of hand. Many a model has suffered badly in appearance through careless painting or untidy lining-out, and the admiration which the good construction may deserve is much discounted.

There are so many things in engineering from which the model maker can select an interesting prototype as a subject for his skill that it seems as though he must be especially railway-minded for his choice to fall upon a locomotive. I think this predilection is true of many people and it is often because of a desire to build and possess a locomotive for its own sake that the model-making hobby is embarked upon, rather than from a general love of mechanical work. This admiration for the prototype on the real railroad will add much to the interest and pleasure of constructing the miniature replica. A marine engine or a set of pumping machinery or a crane might offer equal opportunity for interesting machining and fitting work, but to the railway enthusiast the locomotive is outstanding in its magnetic appeal.

Steam Locomotive Models

The Question of Detail

In the making of a non-working glass-case model, a decision of some importance is called for—shall the model be complete in every detail or shall it be complete only so far as it is visible to the eye? For example, shall the boiler be fitted with tubes and other internal details and shall the cylinders have actual pistons or only piston-rods? The model with externals only will be less complicated to build, but will be equally convincing to the observer who is not in the secret of its internal shortcomings. Moreover, it may satisfy the purpose of a builder who only desires to have a portrait model of a type of engine which has aroused his interest. The question is really one for the model maker's own sense of perfection to decide, and also for his own satisfaction as to the extent to which he has achieved his initial aim. The wonderful model "Como," illustrated in Chapter IV, was intended by Dr. Winter to agree with its prototype in every detail, and the meticulous care he took in tubing the boiler, and in installing the internal details of the tender show that no trouble was too great for him to ensure the building of a perfect model.



Mr. James C. Crebbin's famous model "Cosmo Bonsor," showing the stirrup seat for the accommodation of the driver. This engine has hauled over 100,000 passengers at various exhibitions.



The "Midge"—a tank locomotive built by Mr. G. H. Buckle. His wife enjoys driving the engine, while he enjoys being "taken for a ride."

Although much of this work is not visible, I am quite sure that Dr. Winter is happier in knowing in his own mind that it is there, and that his model is complete.

First Steps in Locomotive Modelling

The first stage in building a model locomotive is the possession of a set of drawings, not necessarily in full size, but at least accurately set out to scale. If the hobbyist has his own ideas on locomotive design, he will naturally prepare his own drawings, but if he wants to reproduce a prototype engine from real life he must rely on obtaining drawings from some published source such as one of the engineering journals or a book on locomotives, or he must apply to the railway company concerned for assistance with official drawings. The Chief Mechanical Engineer of a Company and his staff have plenty to do without setting out to supply valuable drawings to every model engineer who applies, but if a satisfactory reason can be given for the request, and if some proof can be given that the drawings will be put to good use, the model maker may meet with a sympathetic and helpful response. I should like to place on

Steam Locomotive Models



"Right away" for a happy railway ride.

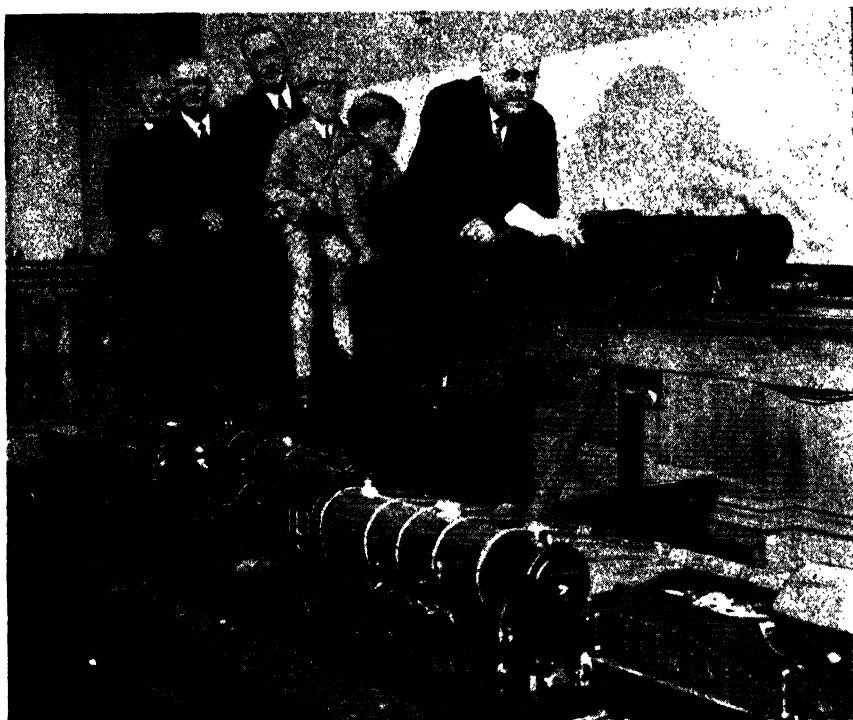
record my warm appreciation of the official help which has often been given in this way, and to express the gratitude of many model engineers who have received much kindly encouragement and assistance from the chiefs of the principal railway companies. This co-operation has led to the preservation in miniature form of notable engines, the prototypes of which have long since passed to the scrap-heap, and so a valuable link in railway history has been forged for the benefit of future generations. Photographs of locomotives are valuable material for the model maker. They not only give him the personality, so to speak, of the engine he is building, but often enable him to check up on details which may not be clearly understood from the official drawings, or which may be missing from a drawing which is only a so-called "general arrangement." If he is delving into history and building a model of an old-timer, for which current drawings are not available, he will do well to consult books on locomotives and railways which are now out of print but which may be found at a good reference library, or even on the shelves of a second-hand bookseller. Back volumes of such journals as *The Engineer*, *Engineering*, *The Railway Gazette*, or the *Locomotive Magazine* may also be consulted with possible advantage.

Steam Working Models

Now let me pass to another phase of model locomotive building, the working model intended for steaming on a track and even for hauling a load of live passengers. The development of interest in this branch of model engineering during the last twenty years has been truly remarkable, not only in this country, but in the United States of America and in Canada. It is safe to say that hundreds—I might even say thousands—of successful miniature engines have been built in home workshops, and have given untold entertainment not only to the builder, but to his family and friends. These engines range from 2 in. up to 12 in. in gauge, and, according to their size, will haul from two or three up to forty or fifty adult passengers on the track. The driver may sit astride the tender or may be more comfortably accommodated on a special trolley of saddle form with stirrups below on which to rest his feet. Similar trolleys may be provided for the passengers, or, on the larger gauges, trucks with proper seating comfort may be provided. A glance at some of our photographs will show how the driver and passengers are carried. The construction of a safe and suitable track is another responsibility for the model railway engineer, whether it be a comparatively short straight track in a suburban garden or a continuous undertaking on a larger scale on an estate or in a public park. Several of the principal model engineering societies have built communal tracks for the use of their members. These are usually laid with two gauges $3\frac{1}{2}$ in. and 5 in., so that two sizes of locomotives can be run. One factor which limits the gauges on these society tracks is the portability of the locomotives, which usually have to be brought some distance from the members' homes. For passenger-carrying tracks in large gardens, where space is available, $7\frac{1}{4}$ in. is the most popular gauge, corresponding to a scale of $1\frac{1}{2}$ in. to the foot, or one-eighth full size. Such a model would be from 7 ft. to 8 ft. in length, would weigh in working order about 800 lb. and would work at a pressure of 100 lb. per sq. in. The next larger gauge is $9\frac{1}{2}$ in., corresponding to a scale of 2 in. to the foot.

A few still larger private miniature railways have been laid down in gauges of $10\frac{1}{4}$ in. and 12 in. The larger the scale of the engine the longer must be the track to enable it to show its paces. There is not much fun in starting up on a short track and having to shut off steam almost at once to prevent a collision with the buffer stops at the end of the rails. Among the owners of notable private miniature railways may be mentioned the late Sir Berkley Sheffield, Bart., the Duke of Westminster, Captain C. F. Ward-Jones, Mr. H. W. Franklin, Captain J. A. Holder, and the Marquis of Downshire.

Steam Locomotive Models



The late Lord Stamp driving a miniature steam locomotive on the passenger track at "The Model Engineer" Exhibition. The author and his two grandsons are behind the driver.

Some Notable Locomotive Enthusiasts

There are a number of very enthusiastic amateur workers in this field to whom tribute should be paid so far as my space permits. Mr. James C. Crebbin, for instance, has given remarkable service, not only in experimenting with and building most successful engines, but in demonstrating his locomotives at exhibition and society gatherings in all parts of the country. His enthusiasm and buoyant personality and his unfailing desire to help the younger generation of model engineers have gained for him the affectionate title of "Uncle Jim," and he receives a most cordial welcome wherever he goes. His famous locomotive "Cosmo Bonsor" has run on the track at every *Model Engineer* Exhibition, and during its long life it has hauled the prodigious total of over 100,000 passengers. His other engines "Aldington," "Sir James Milne" and

“Live Steam” Enthusiasts

“Sir Felix Pole” are almost equally well known wherever model engineers gather together, and if “Uncle Jim” is at the throttle an admirable running performance is assured. Mr. Crebbin, now retired from an important post in the Bank of England, has journeyed far afield to spread the light of model engineering. He has visited Norway and Sweden, the Mediterranean, and South America, and wherever he has gone his geniality and enthusiasm have proved him to be a real model engineering ambassador. In almost every club and society there are one or more locomotive experts who build excellent engines of their own design, which by their performance on the track arouse admiration and a desire for emulation, and so the “live steam” germ is continually spreading its infection. In the Society of Model and Experimental Engineers notable locomotive personalities are Mr. W. Hart and Mr. Victor Storey, who are always to be seen on duty at exhibition times, and Mr. C. M. Keiller, whose enthusiasm for experimental work is so well known. My editorial colleague on *The Model Engineer*, Mr. J. N. Maskelyne, is another “dyed-in-the-wool” locomotive expert. I think his knowledge of locomotive history and of real railway practice is unrivalled, for it has been his life’s hobby. But he is equally at home in miniature scales, and has some first-class passenger-hauling designs to his credit.



“Oiling up.” A scene on a realistic private estate railway.

Steam Locomotive Models

Where to See Miniature Locomotives at Work

I could write for a long time on the extraordinary fascination of the miniature steam locomotive at work, but a more convincing proof to my readers would be to pay a visit to one or other of the societies where a track may be seen in operation. If the secretary is communicated with in advance a suitable date could be arranged and a cordial welcome would be assured. The visitor might even be allowed to handle the controls of a locomotive himself and experience the thrill of being a real engine driver. But these little locomotives are powerful things, and, unless the visitor knows something about the operation of an engine, he would be well advised to proceed warily. It is a great tribute to the admirable design, construction and handling of these "babies" on the track that an explosion or an accident to any passenger on the train is almost unheard of.

VII

SHIP AND BOAT MODELLING

Model Sailing Ships, and Power and Speed Boats

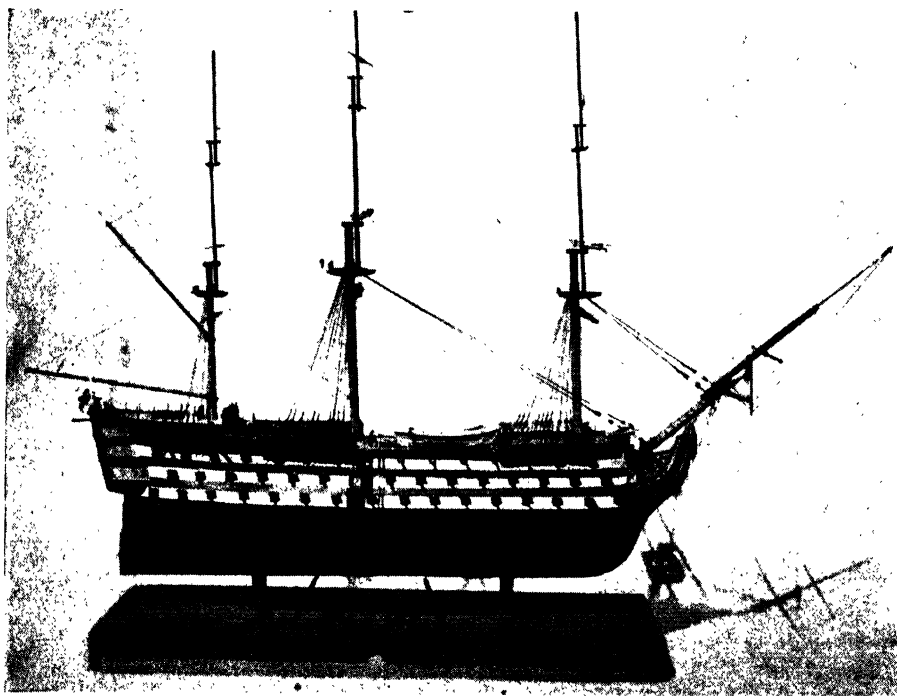
THE ship in all its various forms is such a lovely thing and is linked with so much romance in the days of sail, and so much that is wonderful in the modern years of power propulsion, that it is not surprising to find it a source of inspiration to many model engineers in their selection of a prototype to reproduce in miniature. It is true that the modelling of old-time sailing ships calls for such different materials and such a different type of craftsmanship from the building of model steamers and speed boats that it might possibly be regarded as a hobby quite distinct from that of model engineering. Yet it is a fact that many beautiful sailing ship models have been built in workshops which have previously been equipped and used for the production of locomotives, petrol motors, or model traction engines. The model engineering hobbyist has a catholic taste, and the neatness of miniature work, whether in wood or in metal makes a definite appeal to his mind. There is no denying the beauty of a full-rigged sailing ship or the meticulous accuracy called for by its wealth of constructive detail. For this reason, we sometimes find that when a locomotive or an internal combustion engine has been successfully completed, a change of interest is sought in the modelling of a galleon or a clipper, or a warship in sail, or a liner, particularly if the prototype selected has figured prominently in the history of sea adventure. A notable example of this flexibility of handicraft skill is to be found in the work of Dr. C. N. Longridge. Originally absorbed in the mechanical engineering involved in the machinery of a cargo boat, and having produced a really first-class set of marine engines, he became interested in the famous clipper, the *Cutty Sark*. He made a perfect scale model of this beautiful ship which has had the honour of being accepted on loan by the Science Museum, after achieving much admiration and distinction at the *Model Engineer* Exhibition. Dr. Longridge has followed up his love of ships by embarking on a model of the *Victory* which, when

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completed, will doubtless be a similar example of faultless craftsmanship.

Famous Sailing Ship Prototypes

The sailing ship modeller has a long and attractive range of individual subjects from which to choose. If historically-minded, he may turn back to Elizabethan days and build an *Elizabeth Jonas* or a *Golden Hind*. He may even fancy the *Santa Maria* of Columbus, or in later days the famous *Maryflower* of the Puritan Fathers. The story of warships in the days of sail will provide him with numberless examples of impressive ship designs leading up to the *Victory* of Nelson's glorious years. A good sailing ship model is rightly regarded in many homes as an interesting and decorative piece of furniture, but the model maker should not be led astray into thinking that a highly-coloured and perhaps elaborate representation of an old-time galleon is necessarily a model of which to be proud. The true model maker demands historical accuracy in his work, and it is important that when deciding to build a galleon or a "first-rate"



A model of the famous "Victory." Built by Mr. A. D. Foster while stationed at Abadan, near the Persian Gulf.



A fine model of Drake's "Golden Hind," built by Mr. L. A. Stock, a London Transport driver, who makes a study of nautical history.

man-of-war he should have authority on which to build. Many so-called "galleons" are on sale in the furnishing shops, pretty to look at, perhaps, but having no real resemblance to the ships they purport to represent. Some guidance as to what a ship model should be may be obtained by a visit to the Science Museum, South Kensington, the Museum of the Royal United Service Institution, in Whitehall, or the National Maritime Museum at Greenwich.

The Naming of Ship Models

A word of caution may here be given on the subject of naming ship models. Some enthusiasts having completed an imposing-looking model, decide to give the ship a name and, because the model in its general character looks something like a well-known sailing ship or a liner of a

Ships and Boats

definite period, give it the name of its alleged prototype—the *Ark Royal*, or the *Victory*, or the *Queen Elizabeth*. This is a most undesirable procedure, since it directly invites criticism of design and details which may be inaccurate and may at some future date lead to confusion among students of nautical history as to whether the alleged prototype was of this design or not. A named model should be a faithful representation of the prototype in all possible respects.

Miniature Water-line Models

Ship modelling is an attractive hobby in that good models may be made to any size and in any degree of either simplicity or elaboration. Miniature water-line models are very fascinating to those who possess delicacy of touch. A water-line model is one in which the hull is not made in its entirety, but is reproduced only down to the water-line of the ship when afloat. The model may then rest on a miniature sea, and, in a

suitable scenic setting, it will look very effective. In these tiny models it is not possible to include every detail of the ship's structure or rigging, but if the main features are accurately reproduced to scale, and the colouring carefully applied, the effect is very good and the ship is distinctly recognisable. It is most important that accurate scale should be preserved throughout, otherwise the model will look crude and clumsy, particularly if the masts and spars and ropes are over scale. Strands of surgical silk form an excellent material for rigging miniature models, while some model makers have achieved very realistic results by using human hair for the finer ropes. If the model maker decides to build a fleet of miniature models, such, for example, as the ships of a particular



A waterline model of the "Favell," made by Mr. E. Bowness. Scale 1/32 in. to the foot

Miniature Ship Models



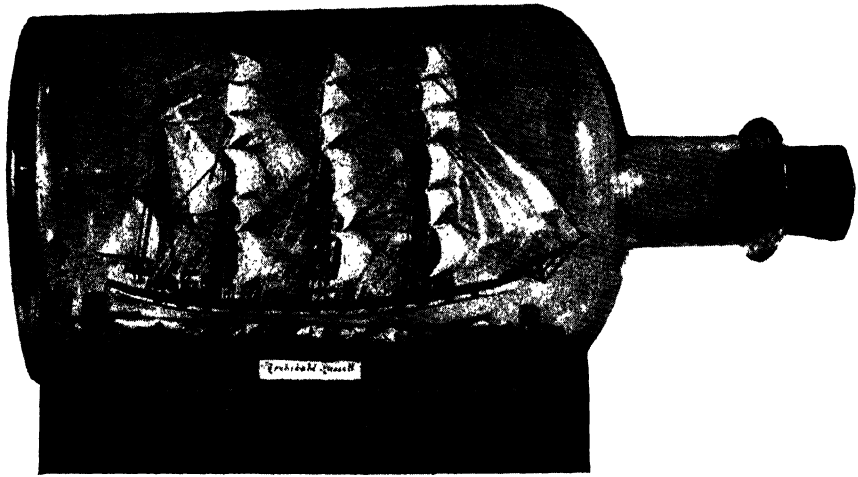
A perfect miniature of H.M.S. "Greyhound" at speed. Built by Mr. Charles J. Hampshire. Scale 1/64 in. to the foot.

steamship company, he should adopt a uniform scale for all the models so that comparison of size and design may be effectively made. Similarly, if he builds models to illustrate the progress of shipbuilding at different periods a uniform scale is both impressive and instructive. Mr. G. H. Draper, a well-known modeller of miniature ships, always works to a scale of 100 ft. to the inch. Thus the model of a ship 600 ft. long would be 6 in. in length. Though this scale produces very delicate and pretty miniatures, it calls for most minute and exacting craftsmanship, not within the reach of everybody. It means, in fact, modelling through a magnifying glass. Another specialist in small water-line models, Mr. Charles J. Hampshire, prefers the larger scale of 64 ft. to the inch. He has produced a number of beautiful models both of sailing ships and modern warships in very complete and graceful detail. He usually places his model in a sea-setting, and, as an old sea-going marine engineer, he is familiar with the sea in all its aspects. Wave proportions and formations are reproduced as faithfully as the ship itself, and the result is most realistic.

A Ship Model as a Portrait

A good ship model should be a portrait of its prototype. It need not necessarily include every detail of the real ship, but its main proportions should be accurate, and the principal features of its rigging and superstructure should be faithfully reproduced. The model, in fact, should be recognisable at a glance. I remember on one occasion going round the *Model Engineer* Exhibition with a ship's officer. Suddenly he said, "Why, there's the *Quathlamba* ; we lay alongside her in Calcutta." He had spotted this model from a dozen yards away and recognised it at once.

Ships and Boats



The "Archibald Russell" in a bottle. Constructed inside the bottle by Lt. A. Morrice, R.N.V.R., during mine-sweeping operations.

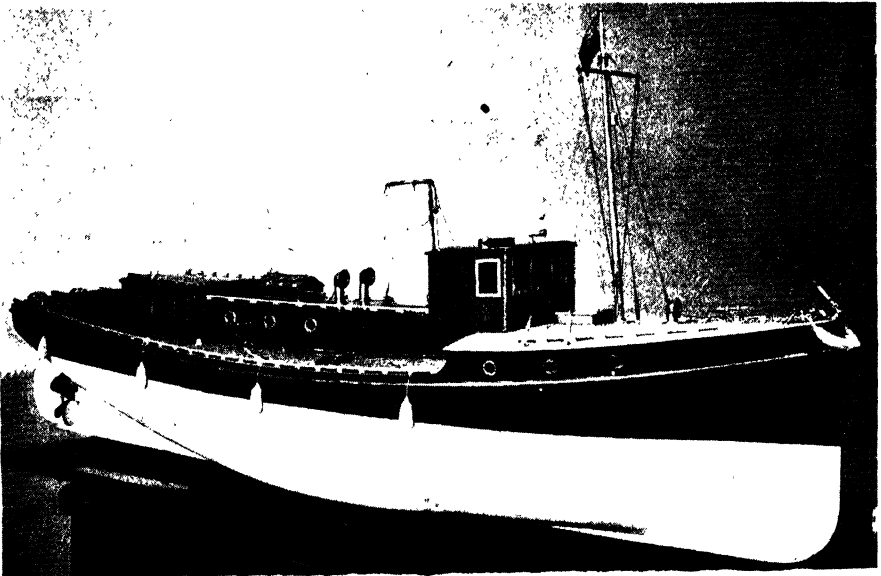
That was a great compliment to the accuracy of the model. Ships are modelled for various reasons ; it may be that the prototype had some interesting family association, or it may have made glorious history. The *Victory* is always a popular subject, and since it is well preserved at Portsmouth, and open to public inspection, the model maker has the fullest opportunity of checking up on the progress and accuracy of his work. Moreover, very complete scale drawings are available. Other popular prototypes from the days of sail are the *Santa Maria*, *Golden Hind* and *Mayflower*, and in later years the *Cutty Sark*, *Thermopylae*, *Archibald Russell* and other famous fliers of the clipper period, have found many admirers. Among the lesser craft in sail Dutch yachts, the "Geordie" brig and the Thames barge afford attractive prototypes, while a topsail schooner in full sail is as pretty a sight at sea as it is when neatly reproduced in model form. It is not always the pretty ship which challenges the ingenuity of the model maker. I remember a most effective model entered at one of the *Model Engineer* exhibitions. It was a representation of nothing more beautiful than a coal hulk, and yet the maker had chosen this subject for the exercise of a highly creditable display of ingenuity and realism in recording the sad ending of a once famous clipper ship. It is true the beautiful lines of the hull could still be seen, but the rust and the grime and the seaweed which had descended upon it in its old age were all faithfully reproduced in the model. As a very

Bottle Models

clever and unusual portrait of a one time lovely ship in its declining years, this model deserved and received high commendation.

Ship Models in Bottles

One of the curiosities of ship modelling is the insertion of ship models in bottles, a favourite occupation among sailormen. The layman is often very puzzled to know how a model ship with its tall masts can be assembled inside the restricted space of a bottle, the neck of which is far too small to allow a completed model to pass through. The secret is that, while the hull of the ship is small enough to go through the neck, the masts and rigging are hinged to the deck and folded down when the model is inserted. The hull is pressed on to a foundation of putty or soft plastic material to hold the model firmly in position. A thread attached to one of the masts and running out through the bottle-neck is then pulled taut. This causes the masts and rigging to rise up into position ; the thread is then fixed with a spot of liquid glue, and the projecting end is cut off. The plastic foundation is usually coloured to represent the sea, and sometimes the scenic realism of the model is increased by the addition of a miniature backing of a coast line, with a lighthouse or other buildings. Miniature ship models of this kind are sometimes built into watches, electric light bulbs or other curious containers.

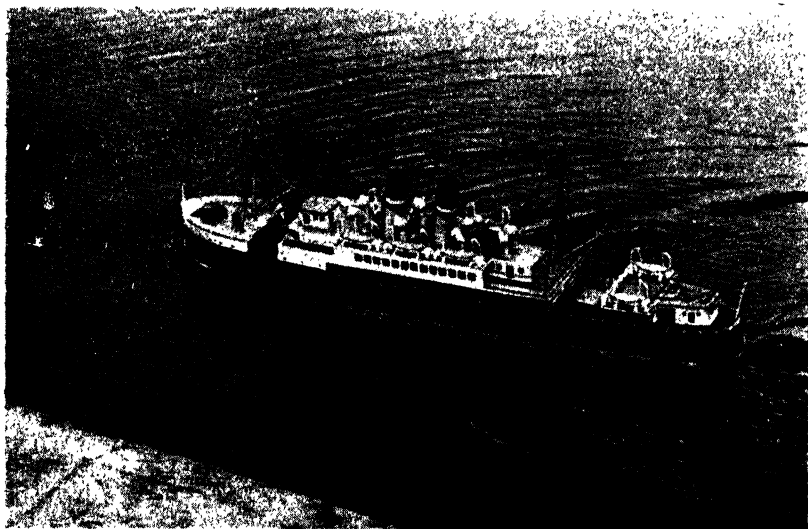


An example of clean modelling. A naval picket boat in full detail.

Ships and Boats

In the world of power-propelled ships there is an endless range of subjects to arouse the model maker's interest, whether he be content with a water-line miniature or with a fully-modelled glass-case effort, or whether he goes a step further and produces a working model with electric motor, petrol motor, or steam engine and boiler complete. Trawlers, ocean tramps, tugs, yachts, river launches, paddlers, and cross-channel boats all have their attractions, while the famous Cunard, P. & O., Royal Mail, and other liners form a galaxy of marine beauty which few ship modellers can resist. The working model steamship has one point of advantage over its prototype in that no internal cargo space or passenger accommodation is required. The builder has the full run of the hull for his power plant, which therefore need not have any real relation to the plant in the prototype either in type or scale.

A model *Queen Mary* propelled by an electric motor and battery instead of steam turbines may not be true to type internally, but it will look just as effective when at speed in the water. Models built for working should not have too much fine detail above deck, as this is likely to become damaged while handling the boat at the water-side. The deck and deck fittings must also be arranged to be readily removable to give easy access to the power plant within. A steam tug is a particularly good type of model for regular running, as it is robust in construction and



"The Liner She's a Lady." The Zeeland Steamship Co.'s "Orange Nassau," modelled by Mr. Victor B. Harrison.



A model convoy afloat in a garden pool. The models all built by Mr. Victor B. Harrison.

provides ample internal space for a simple but effective type of engine and boiler. The graceful paddle steamers which are so popular on the Clyde and Thames and in the Solent are always attractive subjects for the model shipbuilder, and a particular prototype may recall many happy holiday memories.

Mr. Victor B. Harrison's Fleet of Models

I have mentioned in a previous chapter the enthusiasm of Mr. Victor B. Harrison for model railways, but he has a very wide outlook on the attractions of model making generally and is equally at home with model ships as he is with locomotives. As a yachtsman, he is a real lover of the sea, and spends much of his hobby hours in the making of remarkably realistic models of liners, cargo boats and paddle steamers, all of which, be it noted, are working models. He is fortunate in having a small pool in his garden on which he can assemble his ships and demonstrate their capabilities. Mr. Harrison is critically accurate in the scale proportions and realism of his model ships, but he goes much further than this in the ingenuity he displays in equipping them with suitable propelling machinery. He is constantly experimenting with engines, boilers, lamps, paddle wheels and propellers, with the object of getting the greatest efficiency and a continuous performance of his models. He has built quite a fleet of miniatures of notable ships, and when drawn up in review order on his pool they make a very effective and pleasing spectacle.

Warship Modelling

The Royal Navy in itself provides a never-failing selection of prototypes from the gigantic battleship down to the motor torpedo-boat or ship's

Ships and Boats



Hydroplanes and speed-boats at a Swindon Club Regatta.

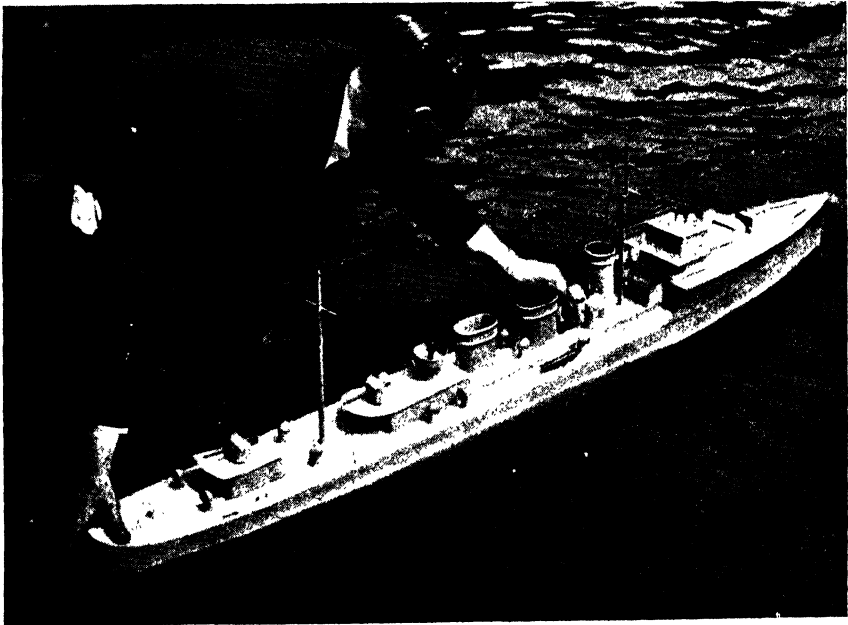
pinnacle. The battleship or large cruiser affords scope for a tempting display of armament and deck fittings for the lover of modelling in detail, while the destroyer, with its greyhound lines and air of high speed and destructive purpose, is always a favourite with the model maker who is out for effect on the local lake. Whatever type of ship is modelled, care should be used to see that the general colouring scheme and the finish of fittings and materials are correct. It will not do for the model maker to build a model from a prototype design and then paint or decorate it to his own fancy. All the shipping companies have their own colour schemes for their

ships and their own funnel colours and markings. Indeed, many cargo steamers are so much alike in general design that their identity is often only revealed at a distance by the rings, or colours, or badges which they bear on their funnels. Cranes, davits, winches, ventilators, guns and cables should be made of realistic material or coloured so as to represent such material. A brass anchor or anchor chain is never seen on a real ship and, though polished brass or silver may give a pretty effect in the eyes of the lay observer, their inappropriate use rouses well-merited criticism from the true ship lover. When visiting an engineering exhibition some years ago, I was amazed to see brass guns projecting from the gun ports of an otherwise excellent model of a modern cruiser. This model was on the stand of a well-known ship-building firm, who apparently valued their reputation so little that they allowed the public to imagine that they fitted their ships with brass guns! In the windows of some of the shipping companies most elaborate models of passenger liners may be seen, completely spoiled by the lavish use of brass and silver-plate in the deck fittings, quite out of keeping with real shipbuilding practice. Another point on which care should be exercised is in the choice and position of any flags which are shown flying. There

are strict nautical codes, both naval and mercantile, governing the correct use of flags, and these should be studied and observed.

Model Speed Boats

An outstanding development in model power boat building in recent years has been the design and performance of speed boats for racing. In the early days of *The Model Engineer* a speed of four to five miles an hour was considered a good performance for a model torpedo-boat or liner. Enthusiasts began to aim at higher speeds, encouraged, no doubt, by the increasing speeds achieved by naval and motor-boat prototypes. To stimulate interest in this aspect of model boat building, *The Model Engineer* inaugurated an annual speed boat contest, in which medals and certificates were offered for competition. The effect of this was remarkable. It not only influenced the design of hulls intended for speed, but it brought intensive consideration to the problem of installing machinery of maximum power in a hull of limited size. For the purpose of the competition, separate classes were arranged, based on the displacement of the boats, so that the builders of small craft had as much



Mr. Berry launches his model destroyer at a regatta of the Victoria Model Steamboat Club.

Ships and Boats

chance of achieving distinction as the builders of the larger boats. Speeds rose rapidly year by year. Records of 10, 12 and 15 miles per hour were quickly established. But speeds as high as this over a straight course brought unexpected difficulties. It was found that a floating twig or leaf caught up in the rudder or propeller was sufficient to divert a boat from its true course, with the result that it would charge the bank of the lake at a spot where no one was available to check it. A number of boats were wrecked by their sudden impact with a solid bank, and where there was a shelving edge to the water, a boat would sometimes leap into the air when finishing its run, to the discomfort of, and even serious danger to, the spectators on the bank. Even when the boat kept its course, it was difficult to stop it at these high speeds. There was always a man with waders in the water waiting to catch the boat, but damaged hands frequently resulted, and I have even seen this unfortunate official knocked off his feet by a fast heavy boat. Then the late Mr. Herbert Teague, himself an enthusiastic builder of speed boats, suggested running the events on a circular course "round the pole." In this method, the boat is tethered by a light flexible cord to the top of a short post anchored in the centre of the lake. It is thus held on a circular course, and can reel off lap after lap without injury to itself or any spectator or other craft. The boats naturally run only one at a time, and the time for each lap is recorded by a stop-watch or by an electrical timing device. With a known length of tethering cord, the distance run for each lap is determined, and time taken over a given number of laps enables a figure of miles-per-hour to be established. This circular course method of racing has been generally adopted by all the model power boat clubs which hold speed events, and it has resulted in a truly remarkable development of speed records. In pre-war days speeds of over 45 miles per hour had been officially achieved and recognised, and in unofficial trials the 50-mile figure has been reached. The breaking of a record is the outcome of great patience and experience, and needs an additional but very definite element of luck. On provisional trials a boat may give an astonishingly fine performance, raising great hopes for the blue riband on the regatta day. Yet when the day comes some minor trouble may develop, the engine may not be absolutely in tune, or some slight obstruction or disturbance of the water may be encountered. But, all being well the boat roars round the appointed number of laps, and another record is broken. As a sporting event, model speed boat racing is a fascinating hobby. The competitor designs, builds and runs his own boat, and when he achieves success he receives unstinted congratulation. These races are not only exciting for the competitors ; they provide a real thrill for the



"Away she goes"—Mr. A. W. Cockman releasing his flash steam hydroplane "Ifit VI," on a circular course trial. She made a British record of 44 m.p.h.

spectators, of whom hundreds usually line the banks of the lake on regatta days. The roar of a model petrol-driven boat at high speed must be heard to be appreciated. Terrific is the only word to describe it. All these high speed boats are either steam or petrol driven. Petrol boats are in the majority, but steam is by no means outclassed, and cleverly-designed craft with flash-steam boilers have always been either very nearly, or sometimes quite, at the top of the list of record holders.

The Need for More Sailing Waters

Ship and boat modelling will always be a popular hobby with a maritime race, whether for the preservation of historical memories in miniature form or for the every-day enjoyment of seeing a working model afloat under power. The local model boating lake is invariably a centre of public attraction, and it is much to be hoped that in future town planning and development this popular amenity will be kept in mind by the authorities and suitable water provided. The model shipbuilders of Great Britain should receive every possible encouragement.

VIII

SOCIETIES AND CLUBS

Co-operative Effort in Model Engineering

ONE of the most pleasing developments of the model engineering hobby has been the formation of societies and clubs where enthusiasts can gather together under agreeable social conditions and display their models and exchange their knowledge and experience. Most of these bodies cater for the hobby in all its varied branches, but in some instances their activities are specialised in the direction of locomotives, power boats or aeroplanes, or particular sections may be organised within a parent society. The club movement, once started, developed rapidly, and there are now many such bodies not only in this country, but in the Dominions and in the United States of America. They vary in size from a small handful of enthusiasts to a membership running into hundreds.

The "Aylesbury Gang"

One of the most successful of the smaller groups rejoices in the name of the "Aylesbury Gang." It has a secretary, but no rules, no officers and no subscription. The members form a very happy band who meet regularly in their locality and who produce among them some of the finest models made anywhere in the country. Their quality may be gauged from the fact that they include two Championship Cup winners in their ranks as well as other winners of exhibition honours. Once a year they have a dinner party, when a splendid show of the year's work is on view.

How the Club Movement Began

The general club movement started in the offices of *The Model Engineer* shortly after the publication of the first issue of that journal in 1898. Mr. E. L. Pearce, a clever model locomotive enthusiast and a personal friend, suggested to me that, in view of the success of certain clubs devoted to the sport of model yacht sailing, a similar club might be started for

model locomotive men. The idea appealed to me immediately, but I visualised a larger organisation which should embrace all kinds of model engineering. I called a meeting from among my readers and some twenty or so enthusiasts gathered together in our office to discuss the idea. Although the majority of them were strangers to each other, the ice was soon melted, and the proposals I put forward were warmly welcomed. Temporary officers were appointed, provisional rules were drawn up, and a subsequent meeting was arranged. On the suggestion of the late Mr. A. W. Marshall, all those present were asked to pay a token subscription of one shilling. This sum, small as it was, had marked a psychological effect. It convinced the gathering that a real organisation was being formed of which they were definite members and that they were not merely brought together for a general talk from which nothing concrete was likely to follow.

The Society of Model and Experimental Engineers

From this small beginning the Society of Model and Experimental Engineers emerged and grew rapidly. It has now become the leading organisation of its kind in the world. It has a membership approaching 500, an experimental workshop fully equipped with lathes and machine tools of all kinds, an extensive library, and a portable track for locomotive running. It publishes a bright official journal, and the lectures and discussions at its regular indoor meetings are of a most instructive and interesting character. The membership includes not only amateur mechanics, but many engineers of high professional standing who are interested in the hobby. The affairs of the Society are managed by a council, with the assistance of special committees who take charge of the details of the workshop, the track, competitions, the official journal and other subsidiary responsibilities and interests. The present president is the Rt. Hon. Lord Forbes, the secretary is Mr. J. J. Pacey, and the honorary treasurer is Mr. A. J. R. Lamb. The Society has been fortunate in its occupants of the Presidential chair, its long list of Past-Presidents including The Earl of Northesk; Professor H. S. Hele Shaw, D.Sc., LL.D., F.R.S.; Mr. W. Worby Beaumont, M.Inst.C.E., M.I.Mech.E.; Admiral Sir Reginald Bacon, K.C.B., K.C.V.O.; and Sir Felix J. C. Pole. The council has not always gone outside its own ranks in its choice of a President, and among those members who have filled this exalted position may be mentioned Mr. D. Corse Glen, Mr. Basil H. Joy, Mr. A. W. Marshall, Mr. L. M. G. Ferreira, Mr. Will T. Day, Mr. James C. Crebbin, and Mr. T. N. Gilbert. Mr. Will Day, during his year of office, propounded a scheme for the establishment of a

Societies and Clubs

permanent headquarters building, where members should be able to enjoy all the social amenities of a club, and that in addition there should be a workshop, a lecture room, a library, and a fixed locomotive running track. This scheme was naturally very attractive, but its ambitious nature called for a greater measure of finance than the members felt they could then afford. Perhaps it may yet materialise, but at least the workshop and library are in flourishing existence and the financial stability of the Society is such that expansion into more convenient and adequate permanent quarters is not outside the realms of future realisation. In recent years the Society has adopted an affiliation scheme to bring other societies in the London area into closer association. Several such societies are now affiliated to the parent body, and their members are thus enabled to enjoy increased facilities for the effective pursuit of their hobby. For many years the Society has held meetings at the Caxton Hall, Westminster, but for a time it found temporary accommodation at 39, Victoria Street. Notices of its meetings appear regularly in *The Model Engineer*, to which the present reader is referred for information. I would add that visitors are always sure of a cordial welcome at these meetings, and many model engineers visiting London from overseas have found the Society a valuable centre of introductions and new friendships. The Workshop and Library are permanently located at 20, Nassau Street, Mortimer Street, London, W.1, and are available to members at prescribed hours. The workshop is a great convenience to those members who are not fortunate enough to possess a workshop of their own, or who wish at times to have the use of more elaborate machines or special tools which are not included in their own equipment. A tool-lending system is available whereby members can borrow, for temporary use at home, tools which may be expensive to buy and yet are only needed once in a while for a specific job. The Society's workshop serves another useful purpose in that it enables expert members to give practical demonstrations in the more difficult branches of workshop practice.

Local and Provincial Clubs

The success of the London Society quickly inspired model engineers in other parts of the country to form local clubs, and a number of these have grown up into very active and modestly prosperous bodies. In the London area alone there are several local societies serving the needs of members who are not situated conveniently for attending the meetings of the parent Society in the heart of the City. Good examples of these are the Malden and District Society, The Kent Society, and the Sutton and District Society. The Malden Society, while catering for all branches of

model engineering, has specially strong sections devoted to model locomotives and model power boats. With the helpful co-operation of the local council, it established an elaborate and well-planned passenger-carrying track in Beverley Park, where "live-steam" meetings were held regularly throughout the summer season, and the performances of the members' locomotives demonstrated to an admiring and enthusiastic public. Thousands of happy people, both young and old, there enjoyed the thrill of a ride on a miniature steam railway. It has since migrated to Thames Ditton, where on a private estate it will have two extensive permanent locomotive tracks and facilities for power boat and model car running and a well-equipped club house.

The Society was fortunate in having had a keen model engineer, Mr. G. F. Goodchild, M.A., B.Sc., as its first President, and it owed much of its early success to the energies of its Honorary Secretary, Mr. G. F. Tonnstein, who kept the members fully informed of current happenings, through a brightly-written "news-letter." Mr. F. W. Bontor, who succeeded to the Presidency, is a tower of strength in his inspiration and practical encouragement.



Mr. W. D. Hollings of the Bradford Society, driving his 3½-in. gauge L.N.E.R. locomotive. Mr. Bower, a fellow club member, is seen behind with a 2½-in. gauge engine.

Societies and Clubs



Another Bradford enthusiast, Mr. Green, drives a 3½-in. gauge L.M.S. 2-6-0 locomotive built by Lt. W. D. Miller, R.N.V.R.

The Kent Society has its headquarters at the Sportsbank Hall, Catford, where meetings are regularly held, and where there is space enough for an indoor locomotive track. The interests of members cover model engineering in all its phases, but locomotives and traction engines are perhaps the most strongly developed sections. The locomotive enthusiasts have contributed very considerably to local entertainment and charitable causes by the demonstration of their engines at outdoor fêtes and galas within their reach. At Sutton there is a very strong society which draws its membership from a wide area ranging from Leatherhead and Epsom to Ewell, Cheam and Morden. They own a plot of freehold ground on the borders of Morden, where they are planning to erect a continuous track for locomotives, a clubhouse, and a pond for power boats. The President of the Sutton Club is Sir Malcolm Campbell, the well-known racing motorist, who is also a keen model railway enthusiast.

The "getting-together" spirit has spread widely throughout the country and there is now hardly a town of any size where an active model engineering club is not to be found. Manchester, Leeds, Rochdale, Burnley, Wigan, Bradford, Nottingham and Norwich all have flourishing organisations, while, in Scotland, Edinburgh and Glasgow are both provided with active and well-managed societies. The Glasgow Society

Model Railway Clubs

treasures a special club album of photographs of its members' work, which gives a remarkable panorama of clever mechanics in miniature. Members at Nottingham and Norwich have made a point of introducing themselves to the public by an annual exhibition of their work. Both these shows contain fine examples of the model maker's art and attract large crowds of interested visitors. The little colliery village of Pinxton in Nottingham is noteworthy too for a splendid annual show of local craftsmanship. Many of the smaller societies make effective displays at local exhibitions, where the model engineering corner is always one of the most attractive features of the general show.

Model Railway Clubs

The model railway hobby has brought into being a number of clubs whose interest is confined to the construction and operation of railways in miniature. Of these the leading organisation is The Model Railway Club, centred in London under the stimulating presidency of Mr. G. P. Keen. In addition to holding regular indoor meetings, this club blossoms out once a year with a very complete and representative exhibition at the Central Hall, Westminster. This is usually held during the Easter holidays, and is a most popular attraction both for the younger generation and for the grown-ups, who follow this fascinating branch of the hobby with undiminished fervour and skill. Among the numerous provincial



How the children enjoy the fun. Mr. C. R. Parkin's locomotive "Midge" has a real passenger load at Alfreton "Holidays at Home."

Societies and Clubs

model railway clubs, that at Manchester is outstanding for the enthusiasm and technical ability of its members.

Power Boat Clubs

Model power boating is catered for in many model engineering societies by a separate section. This is found to work very well where the boat-building members are not especially numerous, for there is much engineering interest involved in the construction of a model liner, or warship, or speed boat and in its equipment with suitable power machinery. There are, however, a number of clubs who confine their activities to power boating, and who find ample scope for enjoyment in regular meetings at the water-side for the trial and demonstration of their models, and in impressive regattas with competitions in speed racing, steering and spectacular running. For the well-being of the racing side of model power boating, and in particular for the establishment and recognition of records, it is important that running conditions should be on a standardised basis. For this purpose The Model Power Boat Association has been formed, and some forty clubs in this country are now affiliated thereto. National and international regattas are held under its auspices and most thrilling races are held for appropriate trophies. When I mention that speeds approaching fifty miles an hour are registered at these events, it will be realised how necessary it is for running conditions and the accurate clocking of performances to be carried out under well-considered and uniform rules if official results and records are to be established.

In London the oldest of these clubs is the Victoria Model Steamboat Club, which holds its meetings at the Bathing Lake in Victoria Park, where there is a well-built clubhouse for the accommodation of boats and gear. This lake has been the scene of many important regattas, when the waterside has been surrounded by hundreds of enthusiastic spectators who have been thrilled by the truly marvellous performances of the faster speed boats. Although racing on a circular course has been the high spot of these meetings, much entertainment has been provided by the stately running of the more leisurely liners, yachts, and warships whose graceful and realistic appearance on the water always evokes much admiration. The steering competitions, too, afford opportunity for success for boats which, perhaps not very fast, are good examples of careful design and steady running. In these competitions the target is marked by a row of buoys, and it is by no means easy for a boat to score a bull's-eye.

On the other sides of the Metropolis the South London Power Boat Club holds very successful meetings on the lake in Brockwell Park, while the West London Club and the Blackheath Club maintain regular

A Fine Power Boat Display



Model power boats always draw the crowd. Here is a miniature Naval Review in progress.

running on their respective waters, the Round Pond in Kensington Gardens and the lake on Blackheath itself. The Wicksteed Club at Kettering has a splendid water available in Wicksteed Park, where some most interesting national regattas have been held, and, further afield, there are flourishing clubs at Bristol, Guildford, Portsmouth, Altrincham, Fleetwood, Tyneside, Glasgow and elsewhere. On Tyneside there is one of the oldest model power boat clubs in the country. Under the title of Tyneside Model Yacht Club, it was formed as long ago as 1893. It concerns itself more with the building and running of realistic steamship models than with racing, and on its water may be seen some splendid examples of the model shipbuilder's craft. It has three sections catering respectively for power boats, hydroplanes and sailing yachts. Most of the power boat clubs hold indoor meetings during the winter months, when various problems of design and construction are discussed.

Model Aeroplane Clubs

In recent years model aviation has aroused keen interest in all parts of the country and numerous model aeroplane clubs have been formed.

Societies and Clubs

The parent body is the Society of Model Aeronautical Engineers, which has done much valuable work in promoting the scientific study of the subject and in organising flying meetings and competitions. The most notable competition is that for the trophy presented by Lord Wakefield and known everywhere in the model world as the Wakefield Cup. This is flown for annually by selected teams from various clubs, and being an international trophy, the event has attracted teams from some of the European clubs and from the United States. On one occasion a British team crossed the Atlantic and regained the cup after it had been previously won by a visiting American team. The competition is decided by the flight-duration performances of the various models entered. Every model aeroplane club holds flying meetings, and some of these are very largely attended. In the London area two notable clubs are the Northern Heights Model Flying Club and the Blackheath Model Flying Club. Both of these have organised gala days open to the whole country and very successful and enjoyable meetings have resulted. The design of model planes on scientific lines is definitely encouraged and some remarkable performances have been achieved. The majority of the planes are driven by twisted rubber skeins, but latterly power-driven models equipped with miniature petrol motors have become very popular. Compressed air has occasionally been tried but is not regarded as a really efficient form of power for propulsion.



Model aeroplanes by the score! The competitors at a model flying club meeting.

Industrial Model Clubs

Model Car Racing Clubs

The building of model motor cars for racing purposes has recently attracted a good deal of attention in this country, following the remarkable performances of model speed cars which have been achieved in the United States. Proposals for forming clubs to stimulate design and to hold race meetings have been made, and The Pioneer Model Car Club now has a very keen membership. The model cars themselves are examples of very clever design and very accurate workmanship. In America the cars are mostly equipped with commercially-made petrol engines, but the model engineers of Great Britain are more thorough in their methods, and usually prefer to design and build their own engines. Petrol engines are adopted by most car builders, but flash-steam cars are being made by a few steam enthusiasts and, as with model power boats, bid fair to hold their own in the racing events. Whether model car racing as a sport will retain the fancy of the British public or not remains to be seen. Speeds are terrific ; fifty miles an hour, on a circular track, is a comparatively modest performance, but the excitement is short-lived. The burst of speed is soon over, the eye can scarcely follow the movement of the car, and the record of the stop-watch is the main satisfaction which both the car builder and the spectators can hope to achieve.

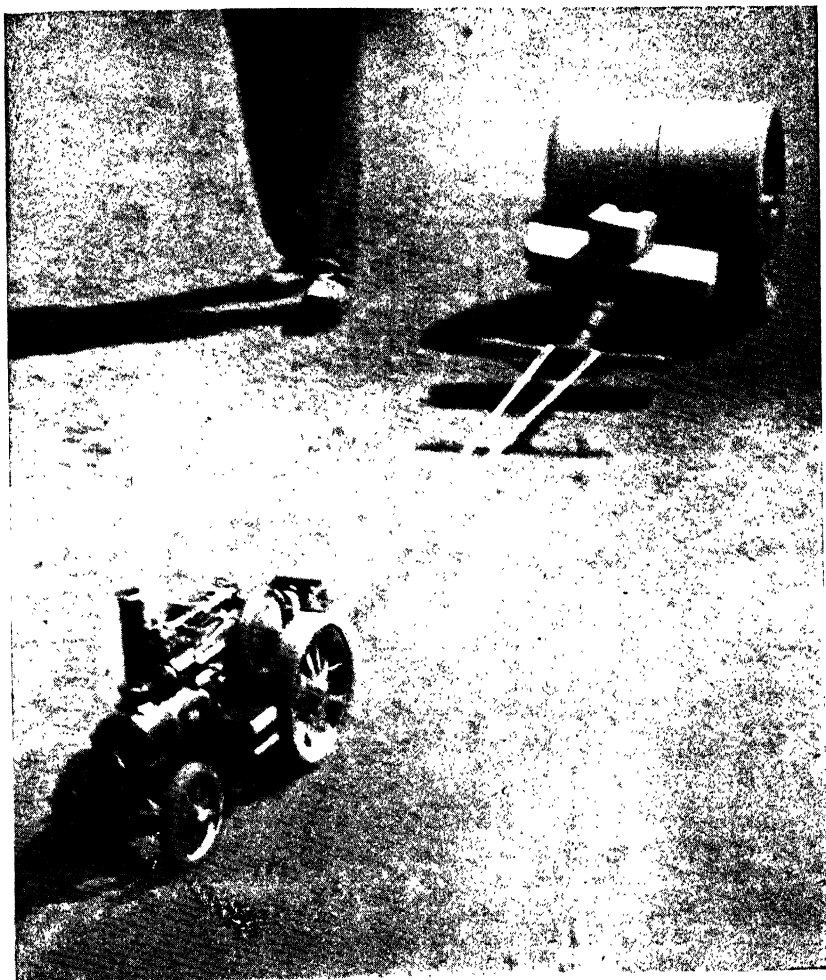
Model Clubs in Industrial Works

A number of model engineering clubs have been formed in recent years in connection with the welfare activities for the employees of large industrial concerns. In some instances model engineering is included in a general scheme for the promotion of arts and crafts, but it often happens that model making has so many followers that a separate model engineering society has been organised. Welfare officers in large establishments recognise the value of encouraging spare-time hobbies among their workers, and an annual display of work so produced is in many concerns an established and very popular feature of the community life. Among notable firms who have given encouragement to their workers in this way may be mentioned Kodak Ltd., the Head Office in London of the General Electric Co. Ltd., the Vauxhall Motor Works at Luton, the celebrated Bournville Works of Messrs. Cadbury, and Messrs. J. and E. Hall Ltd. of Dartford. The Kodak Society, which is now affiliated to the London Society, organises an annual show at which some first-class examples of model engineering work can always be seen. Apart from the recreative value of such a hobby, these displays sometimes lead to the discovery of unexpected talent among the staff, which can be turned to good account both in the interests of the firm and of the individual worker himself.

Societies and Clubs

How to Join Societies and Clubs

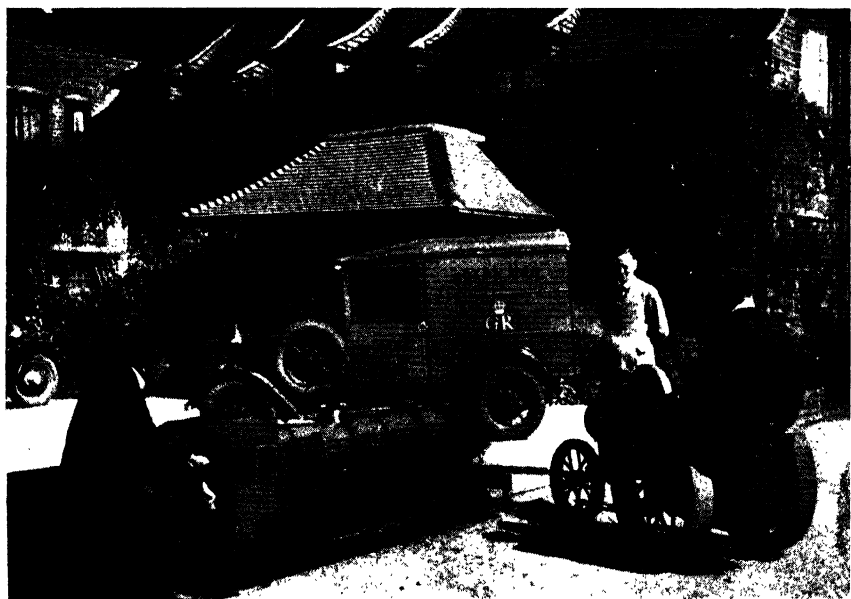
The reader who may contemplate joining a model engineering society can always obtain the address of the nearest body by consulting the club reports in the pages of *The Model Engineer*, or by writing to the Editor. The fact that he is only a beginner need not deter anyone from making application for membership. He will be sure of a cordial welcome and may gain much helpful instruction and advice from his fellow members.



It is cheaper than horse-power! The 1-in. scale, 47-lb. "Jix," built by Mr. A. E. Phillips, hauling a 2½-cwt. roller on a local bowling-green.



A fully signalled terminal on an indoor model railway.



A model rally at the home of Sir John Holder, at Beaulieu, Mr. J. N. Maskelyne on the foot-plate of the locomotive.

IX

MODEL ENGINEERING MAKES ITS BOW

The Wonders of "The Model Engineer" Exhibition

THERE is one event in the year to which every model engineer within reach of London looks forward with the keenest interest. This is the annual *Model Engineer* Exhibition, which has now passed its twenty-first birthday. First organised in October, 1907, it was for a time held every second year, but the interest and the number of exhibits grew so rapidly that an annual show proved to be a necessity. This has become an established fixture in the model engineering calendar, interrupted only by two prolonged war periods, but now being resumed in full vigour. In some respects it is unlike any other exhibition. Apart from the wonderful display of beautiful models, it is the accepted rendezvous for model engineers from all parts of the country. They come to meet old friends and to make new ones, to report on their own doings, and to learn what other folks are doing elsewhere in the model world. They can compare their own productions with the outstanding entries in the Competition Section, they can inspect the latest tools and materials offered by the trade, and they can see famous miniature steam locomotives and other models at work. Moreover, officials and members of societies can meet each other under pleasant conditions, and exchange news and notes of their collective activities. Model engineers bring their wives, and sometimes their families, and the whole affair resembles a gigantic social party of friendly and smiling people drawn together by their common interest in a wonderful hobby and in their knowledge of the good fellowship which will be extended to them everywhere in the building. Visitors come from abroad and many model engineers returning home on leave arrange their visit to the mother country to coincide with the Exhibition dates. Notable engineers and education authorities come to see what clever hobbyists are doing and what is available in the way of technical school equipment and precision workshop appliances. The Royal Navy, Army and Royal Air Force use the exhibition to illustrate the value of their

The "Model Engineer" Exhibition



The queue of patient enthusiasts awaiting the opening of the doors.

instructional courses for trade apprentices and to recruit budding model engineers for a service career. It is in fact a remarkable occasion for the display of fine craftsmanship in all its angles of appeal, and for the demonstration to the public of what model engineering really means.

Where the Show is Held

The Exhibition has always been held in the beautifully-lighted hall of the Royal Horticultural Society in Vincent Square, which is ideal for the purpose, except on the two Saturdays of the Show, when a building twice the size would scarcely accommodate the vast crowds who seek admission. This congestion is accentuated by the many visitors from the provinces for whom Saturday is the only convenient day for travel, but the crowd is invariably enthusiastic and good-tempered and gradually finds its way round the exhibits. The show has been held at varying times in the year, but experience has proved that late August or the first fortnight in September is the most generally acceptable date. Then the daylight in the hall is good, the weather is congenial for travelling, and, coming as it does at the beginning of the indoor season, it enables model engineers to plan their activities in advance and to procure such tools and materials as they are likely to require during the winter months.

Some Notable Opening Days

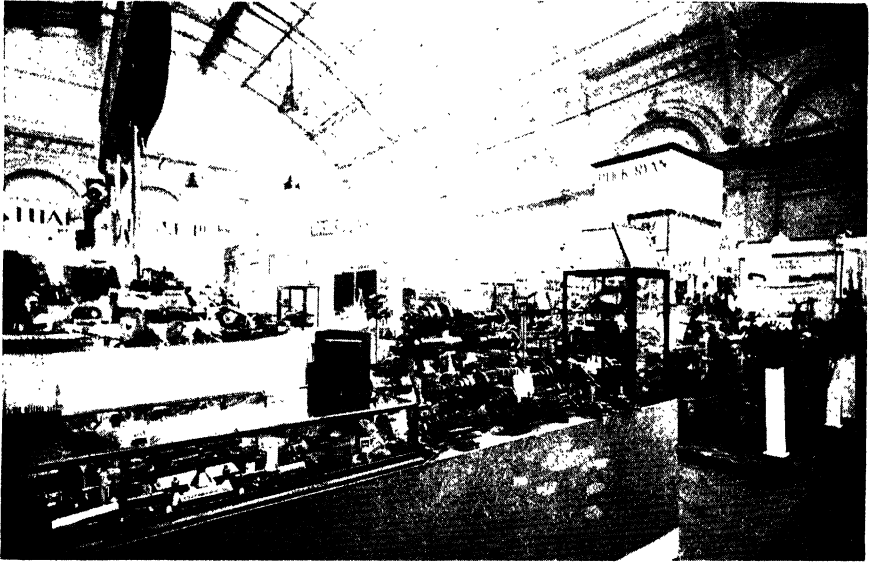
The show has not always been inaugurated by a formal opening ceremony, but on many occasions it has been honoured by the presence of distinguished folk who have undertaken this duty. First among these

celebrities to give his official blessing to the proceedings was the late Sir Hiram Maxim, the inventor of the celebrated Maxim gun, and a successful pioneer in aeroplane design and construction. He made the opening speech in 1909 and on this occasion he was presented with a silver model of his famous flying machine, notable for its most ingenious steam engine plant, which provided the necessary power for an astonishingly low weight. In 1928 there was a very novel opening ceremony when "Eric the Robot" performed the honour. "Eric" was a mechanical man, life-size, who stood up, bowed, and delivered an opening address to the assembled crowd, astonishing them by his unique performance. His various movements were electrically controlled and obeyed the word of command with perfect regularity. The speech reproduction was another clever application of electrical transmission, and the ease with which he replied to questions from the audience, or told the time at any moment from a clock suspended in the room, puzzled many of the visitors.

Among later celebrities who officiated on opening days were Sir Felix Pole in 1931, the late Lord Stamp, then Chairman of the L.M.S. Railway, in 1935, and the Rt. Hon. Leslie Hore-Belisha, M.P., then Minister of Transport, in 1936. All these gentlemen expressed high appreciation of the work of model engineers. Sir Felix Pole said: "Only yesterday I was talking to the manager of a large colliery undertaking in the Midlands and I told him I was coming here today to open this exhibition. He said: 'You may tell the model engineers that I am a great believer in the practical value of model making. I make a point of having all my new colliery developments first planned out in the form of models, and I have saved many thousands of pounds through the use of models for this purpose.'" Lord Stamp said: "So far as a model is concerned, it is easy to model something, but when models are made to scale the work requires the finest of touch, finer perhaps than the touch really necessary in the making of the real object. We need not despise it because it is a model—it may require a greater degree of technical brains." Mr. Hore-Belisha, in the following year, paid a great tribute to the national value of model engineering. He said: "Now let nobody think model engineers are mere visionaries whose skill is only of value to themselves. They are a national asset. They are a national reserve of mechanical ability. During war the model engineer is a key man. In peace—well, we are told that many firms to-day are at their wits' end to find skilled craftsmen. If the directors of such firms would come here and see the class of work model engineers do, they would realise the untapped source of mechanical skill available to help them out of their difficulties." Mr. Hore-Belisha's remarks were truly prophetic. In the great World War which followed so

The "Model Engineer" Exhibition

soon after that year's exhibition, model engineers rallied in their thousands to the technical branches of the Services, and to the aircraft and munition works, where exactitude of craftsmanship was so urgently needed. Many more turned their home workshops into miniature factories where they were able to contribute valuable help in the production of tools, gauges, and the thousand and one small parts required for the construction of weapons for war.



A peep at the exhibition in the Royal Horticultural Hall.

Models in Competition

The competition section always produces a remarkable display of interesting and, in many cases, of high-grade work. While there is a generous list of prizes and diplomas to be awarded, all the exhibits do not reach the prize standard, which has become increasingly higher as the years go by. But every entry is of interest, even if it does not qualify for an award, for it represents a creditable piece of human endeavour, and is carefully examined both by the judges and the visitors. There have been many instances where competitors failing to secure an award on one occasion, have entered again in a subsequent year with a better example of their work and have reached the medal or diploma standard. In this way the competition stimulates progress, and affords model makers an opportunity of comparing their craftsmanship with that of more highly

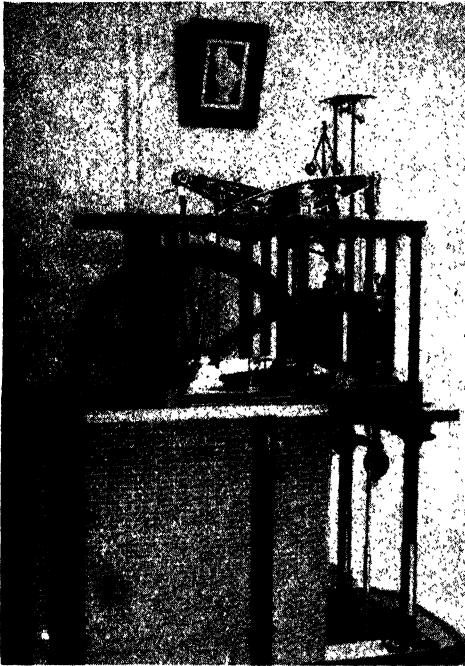
skilled workers, and noting the points wherein their own productions can be improved. In recent years a special class has been provided for junior mechanics under the age of 16, and this has brought forward some surprisingly good examples of engineering talent.

Each competitor is required to describe his entry on an official form, on which he declares whether his model is to be regarded as a true-scale model, or as a working model, or as a demonstration model for experimental or scientific purposes. He is also given space to describe his workshop equipment and any special circumstances under which his model has been built. All these facts are taken into consideration by the judges in appraising the merit of the work, and their awards are made accordingly. The competition is not open to those engaged in model engineering as a trade or business, but engineers or mechanics who do their model making purely as a spare-time hobby are entitled to compete. In such cases the judges expect a higher standard of workmanship than in the case of an amateur craftsman who has received no technical training or workshop instruction. It sometimes happens that the amateur surpasses the professional in his work, and gains a Championship Cup entirely on the technical merit of his exhibit.

The Championship Cups

In the early days of the Exhibition so many really high-grade models were entered for competition that it was felt desirable to institute a special award for the best exhibit in the show. It took the form of a Championship Cup open to the whole country and this proved to be a much coveted honour. But with so many good models of such varied character, the difficulty of selecting one particular exhibit for this honour increased year by year. It was not at all easy for the judges to weigh the comparative merits of a locomotive, a mill engine, a clock, or a sailing or steamship model, so their problems were later relieved by the offer of four Championship Cups, one for each of the following classes : (1) The best locomotive, (2) The best general engineering model or piece of mechanical work, (3) The best model of a sailing ship, (4) The best model of a steamer or motor ship. This has proved to be a very popular arrangement, and the honour is as greatly prized as when only one cup was available. The cups are not challenge trophies, but are won outright each year. Silver and bronze medals, and diplomas of merit are offered by the organisers, and in addition to these there are various cups and prizes generously offered by private donors who desire to encourage some particular class of work or type of competitor. In recent years Admiral Sir Reginald Bacon, K.C.B., has kindly offered a cup for the best model

The "Model Engineer" Exhibition



The model of a set of beam pumping engines which was awarded the Championship Cup, in 1932.

made by a lady, and some excellent examples of work have been submitted.

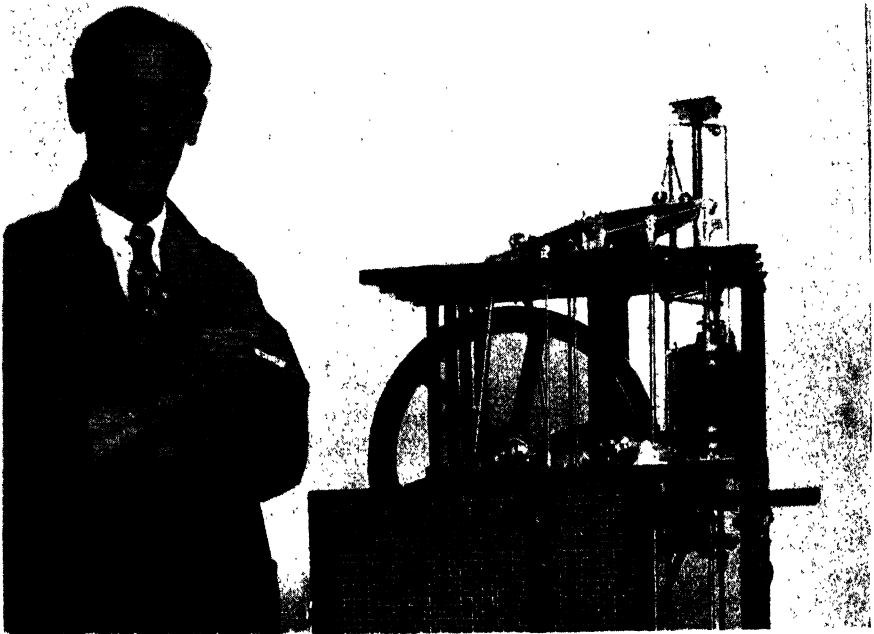
The number of competition entries each year varies between 250 and 300, the actual acceptances depending upon the sizes of the exhibits and the space available for their display. They come from all parts of the country and, although many of them originate from the London area, it by no means follows that London runs away with most of the prizes. Entries from overseas have been offered at various times, but are not accepted owing to the difficulties raised by the Customs and Excise Department in regard to the admission of models into this country. One interesting feature of the competition section is the remarkable variety of the

work entered. It includes locomotives and model railway rolling stock of all kinds and sizes, traction engines, marine engines, mill and other types of stationary engines, petrol motors, models of historical interest, steam cranes, motor cars, tools and workshop appliances, scientific instruments, clocks, architectural models, aeroplanes, old-time sailing ships, warships, models of famous liners, steam yachts, tugs, river launches, and indeed almost every kind of miniature craftsmanship. To unpack and arrange all these models within the few hours available before the opening of the show is a strenuous business and requires the energies of a considerable staff of stewards and voluntary helpers. Once the models are staged, they are constantly inspected and re-arranged in order that they may be shown to the best advantage and collected as far as possible in classified groups. Many points of special interest come to light as the models are examined, and a little card is attached to the exhibit to explain this to the visitor, who might otherwise pass it by.

A Notable Cup Winner

Judging the Competition Exhibits

Although I have always acted as chief judge, it must be obvious that no one person can conscientiously and critically examine this large number of models within the limited period of the Exhibition and appraise their respective merits. I have therefore usually enlisted the services of a panel of experts in the various branches of model making who report to me their opinions of the merits and demerits of the exhibits in their particular field of interest, and in consultation we arrive at a final decision. Although I cannot record the services of all who have very kindly helped me in this way, I should like to pay a tribute to the valued judgment of Mr. F. H. Withycombe, my brother the late Mr. Alfred W. Marshall, Mr. L. M. G. Ferreira, Lt.-Com. J. H. Craine, Mr. George Gentry, Mr. J. N. Maskelyne, and Mr. R. W. Dunn. Mr. Dunn, a previous championship cup winner, has also rendered conspicuous service for many years as chief steward in charge of the competition section. In estimating the merit of a model the judges take into account its accuracy of design, quality of its workmanship and finish, and completeness and amount of detail involved. For the cup and medal awards a high standard of quality



Mr. A. L. Woodward with his model of the beam pumping engines of the Chiltern Hills Water Co. Six-and-a-half years of spare time work.

The "Model Engineer" Exhibition

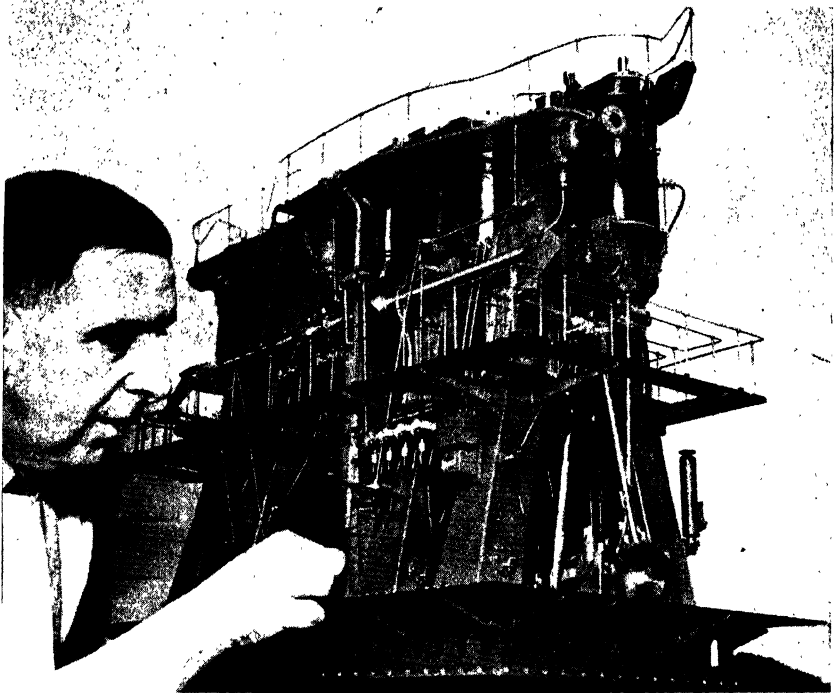
is expected, but for the diplomas, which are graded in character, an endeavour is made to recognise what may be termed general merit ; that is, originality in design, good construction, and the difficulties under which a praiseworthy piece of work may have been executed. There is no doubt that this annual competition has resulted year by year in a steady and very pleasing increase in the general standard of model engineering endeavour.

Some Notable Models

The Exhibition has always been fully reported in the pages of *The Model Engineer* with photographs of the principal models and personal stories of the makers and their methods. For the interest of my present readers, I have selected one or two photographs of prominent exhibits in recent years which will indicate the very high standard of technical quality which has now been achieved by the leading exponents of the hobby.

One of the most truly representative engineering models which has earned the Champion Cup distinction was the model of a set of beam pumping engines shown by Mr. A. L. Woodward in 1932. This was the last occasion on which a single Championship Cup was awarded, and there was no doubt in the minds of the judges in the selection of this model for the honour. Mr. Woodward, who is a member of the famous "Aylesbury Gang," came to see me at the Exhibition for several years in succession, producing on each occasion a portion of a model which he told me he had under construction. Eventually the model itself arrived and excited general interest and admiration. It represents a beam pumping engine built by James Kay, of Bury, between 1850 and 1860. This engine was the property of the Chiltern Hills Water Company and was in active service until 1928. Mr. Woodward had previously gained a diploma for a model horizontal engine, and, encouraged by this success, had decided to build something on a much more ambitious scale. He said he would choose a prototype with a history and one which the general public rarely see. Accordingly, he scoured the countryside on his bicycle examining every engine within range. Finally, he lighted upon the pumping engine he has now modelled with such success. It is worth recording that for two years he spent his week-ends cycling to the pumping station, studying the engine and making dimensioned sketches of all its parts. The model itself is made to a scale of $1\frac{1}{2}$ inches to the foot, and the engine is supported on a solid brick pile laid in the old English bond. The engine frame is built up, and contains 77 pieces, dovetailed and sweated together. The cylinders are $1\frac{1}{4}$ in. bore by $3\frac{1}{4}$ in. stroke, each cylinder having two slide

A Magnificent Marine Engine



Another Championship Cup winner. A magnificent marine engine model built by Mr. S. J. Ward. Scale $\frac{1}{4}$ in. to the foot. Three-and-a-half years' work.

valves. To indicate the great amount of detail in this model, I may mention that there are no less than 54 sets of gibs and cotters. The only castings used were the cylinders, the beams, and a few portions of the frames. All the rest was cut out and built up from solid metal. Even the fly-wheel is built up. The spokes were dowelled and pinned to the hubs, turned up between centres, and the rim shrunk on. The building of the model occupied the spare time of Mr. Woodward for six and a half years. When the Great War started, with its destructive bombing raids, the model was carefully packed and lowered into a well, where in a side cavity of the well-shaft it safely avoided all danger of being wrecked.

Marine engines of the triple and quadruple expansion type are always popular subjects with the model engineer. Not only are they typical of British shipbuilding supremacy, but they are of especial interest from the fact that nearly all their working parts are fully visible to the eye and form a fascinating spectacle when in motion. Moreover, they afford an endless variety of nice mechanical work in the machining and fitting of their

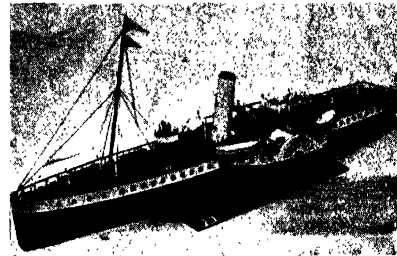
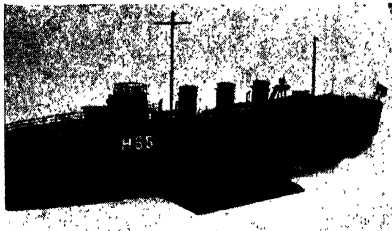
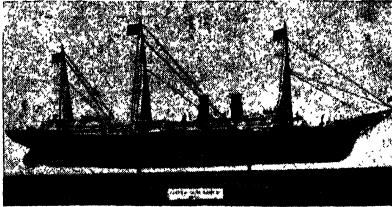
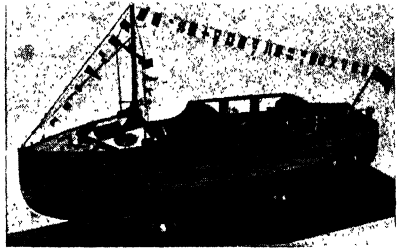
The "Model Engineer" Exhibition

numerous details. Mr. S. J. Ward, of Northampton, exhibited in 1938 one of the finest models of this kind which I have yet seen, and easily secured the Championship Cup in his particular section. He is an industrious and very skilled model engineer. Once a prototype has taken his fancy, nothing seems too difficult or too complicated for him to tackle. In a previous exhibition he gained a cup presented by Admiral Sir Reginald Bacon for a fine example of large-scale model locomotive building. He then became interested in the L.M.S. portable crane at Rugby, and within a short space of eighteen months he built a perfect working model of this elaborate structure, which, for some years, was lent by him for exhibition in the Great Hall at Euston Station, where it found many admirers. He next turned to marine engines for inspiration and approached the famous firm of Harland & Wolff Ltd. for drawings of a suitable engine. The management very kindly responded with a full set of drawings for a quadruple-expansion set giving 6,000 horse-power at a working pressure of 230 lb. per sq. in. Mr. Ward decided to model this engine to a scale of $\frac{3}{4}$ inch to the foot, selecting this size because it would bring the heavier parts down to such dimensions as he could conveniently machine in his home workshop, and would at the same time avoid the smaller details becoming too microscopic in character. Even to this scale, the model is 28 in. overall in length, 19 in. wide, and 24 in. high, and it weighs 4 cwt. The building of the model occupied Mr. Ward's spare time for $3\frac{1}{2}$ years. Being of the quadruple-expansion type, the engine has four cylinders ; one of these is for the high-pressure steam, two for the intermediate ranges of expansion, and one for the final low-pressure steam. Their respective diameters are $1\frac{1}{8}$ in., $2\frac{1}{4}$ in., 4 in., and $5\frac{1}{2}$ in., the stroke being $3\frac{3}{4}$ in. The four-throw crankshaft was built up ; it is 31 in. long, $1\frac{1}{8}$ in. diameter, and weighs just under 50 lb. The model is complete with condenser, which is fully tubed, a turning engine, and governor. The bed-plate, cylinders, and some of the other main portions of the model are built up from raw material to obviate the necessity of making elaborate patterns, and the possible difficulty of obtaining satisfactory castings.

The Variety of Entries

These two foregoing examples illustrate the quality of the models entered for the Championship Cups in the general section, but it may be said that in all the classes at the Exhibition equally impressive work is on view. In the general section, cups have also been awarded to a steam crane, an 18-cylinder internal combustion engine, a grandfather clock, and to other exhibits widely diverse in character, but each showing

Ships of All Kinds



SHIP MODELS IN MINIATURE.

Some examples of the great variety of ship and boat models shown in the marine section of "The Model Engineer" Exhibition. Britain's sea power illustrated by beautiful craftsmanship.

The "Model Engineer" Exhibition

outstanding qualities in conception and craftsmanship. Locomotives have always made a good display, and some very fine examples have every year been submitted to the scrutiny of the judges. Both glass-case and working models are included among the entries, but the competition models are not subjected to any steam trials. The awards are made on the general design and workmanship only, but naturally if a model is entered as a working model its suitability for that purpose is taken into account. Similarly with a glass-case exhibit, its accuracy of detail as compared with its prototype is carefully considered.

The ship model section is always a very popular feature of the show and has increased in interest year by year. The exhibits range from tiny little water-line models, exquisite in scale and artistic execution, to large reproductions of famous sailing ships and modern steam or motor-propelled liners. Every intermediate kind of craft is represented, and every period of ship construction from the decorative Elizabethan era to the most recent warship or speed boat. The exhibits display the results of a wide range of nautical study and research and many of them have eventually found an honoured place in one of the national museums of the country.

The Trade and Club Sections of the Show

The show is divided into several sections, separate in character if not in actual location within the hall. There is the trade section, comprising attractive displays of tools, models, and materials by the leading trade firms ; the club section, being collective exhibits of members' work by representative societies and clubs ; the competition section in which model makers from all parts of the country compete for the Championship cups, medals and diplomas ; and lastly, the loan section, in which private owners display interesting models not necessarily of their own construction and not competing for any awards. In the club section the principal display has always been made by the Society of Model and Experimental Engineers, which has been responsible for the staffing and operating of the 72-ft. railway passenger track. Thousands of delighted visitors, young and old, have been given the thrill of riding behind a real steam locomotive in miniature. One of the most famous locomotives to give service on this track is the "Cosmo Bonsor," built by Mr. James C. Crebbin. This engine has made a regular appearance at the Exhibition from its very early days and is a great favourite with the public. Many other beautifully-built locomotives of various types and gauges are brought by members of the Society and other enthusiasts, and put through their paces under the supervision of a competent and well-

organised track committee. Every locomotive put under steam has first to comply with the official regulations in regard to its construction and its ability to withstand continuous safe working pressure. In the long history of the exhibition no accident of any kind has occurred.

In addition to the track operation the Society has always made a splendid display of models and other work carried out by its members, many of the exhibits working by compressed air, and has operated a well-equipped workshop to demonstrate to visitors how a lathe is used and how models are built. Among other clubs which have from time to time made representative exhibits may be mentioned The Model Railway Club, The Kent Model Engineering Society, The Society of Model Aeronautical Engineers, The Northern Heights Model Flying Club, The Model Yacht Association, The Ship Model Society, The Victoria Model Steamboat Club, and several of the smaller model railway clubs and engineering societies. Many of the provincial societies organise collective visits to the Exhibition, and make friendly contact with their contemporaries in the London area. The club exhibits invariably arouse much public interest as members are always in attendance to explain the models on view and to give information about their organisations and activities. The Exhibition is an excellent recruiting ground for club membership.

In 1946 The Society of Model and Experimental Engineers and the Society of Model Aeronautical Engineers were invited to share with *The Model Engineer* in the organising of the Exhibition. This co-operation resulted in a marked expansion in the range of exhibits, particularly in the model aeronautical section, and in the general representation of the model making hobby. The Exhibition in that year was a record success, over 60,000 visitors passing through the turnstiles. The control of the Exhibition has now reverted to the *Model Engineer*.

An Engineering Panorama in Miniature

A visit to this remarkable exhibition not only discloses the immense variety of interest afforded by our unique hobby, but is testimony of the most convincing kind to the mechanical ingenuity and handicraft ability of the British race. It affords a veritable panorama in miniature of engineering and shipbuilding achievement, and as progress in design and construction develop so will the public interest in the Exhibition continue. But quite apart from its technical excellence lies the fact that the whole of the work on view is the outcome of a hobby. It represents the love of good craftsmanship for its own sake, and the happy enjoyment of many hours of quiet and healthful recreation in the home workshop.

X

MODEL ENGINEERING OVERSEAS

The World-wide Army of Model Makers

ON a ranch in Patagonia there lives a subscriber to *The Model Engineer* who receives his copy of the journal regularly from the hands of a native runner travelling twenty miles on foot through the bush to reach his employer. At La Paz, 12,000 ft. up in the highlands of Bolivia, there is another enthusiast, Mr. Theodore K. Pepper, whose hobby is model shipbuilding. In Dunedin, in the South Island of New Zealand, in Sydney, Melbourne, and Brisbane, in Cape Town and Johannesburg, there are flourishing model engineering societies. These are geographical extremes to which the love of model handicraft has penetrated, but it may truly be said that the influence of *The Model Engineer* has spread to all parts of the inhabited globe wherever the English language is read or spoken.

The Work of American Model Makers

It might be thought that the great continent of North America, so full of inventive ability and mechanical skill, would have been the first overseas country to respond to the fascinating possibilities of engineering in miniature, but this was not the case. Save for an isolated enthusiast here and there, the torch of model engineering flickered fitfully for a time in the United States, and very few people felt its great attraction. Then, gradually, it began to be realised that the recreation afforded by a hobby made a man fitter for his everyday job, and if the dollars went out in the installation of a home workshop, they came back multiplied in the freshness and zeal with which the daily business obligations were approached. Once this idea was recognised model engineering in its various forms spread rapidly. Societies were soon founded in New York, Chicago, Baltimore and San Francisco, in the United States, and in Montreal, Toronto and Winnipeg, in Canada, while today there are dozens of healthy clubs formed to enjoy the sociable exchange of experi-

ence in this most interesting form of craftsmanship. Model engineering as such has many admirable exponents in the ranks of these societies and the numbers of additional enthusiasts who follow model railroading, speed-boat building, model aviation, and model car racing can be counted by the thousand. At one time *The Model Engineer* was so much in demand that it had to be kept under lock and key in the public library in New York.

Miniature locomotives and railways make a strong bid for popular favour, both for the smaller-gauge indoor tracks, and for "live steam" passenger-hauling out of doors. The growth of the hobby may be gauged from the fact that in the United States there are something like one hundred manufacturers and local supply houses catering for the needs of enthusiasts, and their number is ever increasing as the hobby expands. Naturally, American railway practice is followed very closely, but here and there an exile may be found who seeks his inspiration in British railway history, or in the more modern developments at home. The American hobbyist is particularly alive to the value of a good scenic setting for his model railway, and, indeed, many examples may be seen in photographs of transatlantic layouts where the artistic and theatrical sense is as strongly developed as the technical exactitude of the train operation. This all adds variety and charm to the hobby. One of the most elaborate model railway layouts in the United States is that set up and managed by members of the New York Society of Model Engineers. Originally installed in the Society's clubroom in the Astor Building, this has now been removed to fresh premises at 51 West 35 Street, between Fifth and Sixth Avenue, where it has gained a new lease of popularity. For many years this enterprising Society has held an annual exhibition which has proved an outstanding attraction, even for New York, where there is so much to divert the attention of an entertainment-loving and perhaps somewhat restless public. The New York Society also takes a keen interest in speed-boat racing and sponsors the working of the Eastern Model Power Boat Circuit. Meetings are held at local waters, where most exciting and keenly-contested events are run. The meticulous care with which this Society is organised is exemplified in its Book of Constitutions, which runs to 54 pages, and contains rules and regulations covering every branch of its activities.

American "Live Steam" Enthusiasts

An organisation which has done much to foster interest in the building and running of miniature steam locomotives on outdoor tracks is the Brotherhood of Live Steamers, a body 600 strong and having members in



A "live steam" gathering in the U.S.A.

all parts of the United States. It was founded in 1932 by Mr. Charles A. Purinton, of Marblehead, Mass., and at his residence is one of the two extensive tracks where the members can enjoy frequent running of their engines. The demand for running facilities outgrew the accommodation offered by Mr. Purinton's track, and so Mr. Lester D. Friend set up an additional and more elaborate track at his home at Danvers, where an annual gala-day of locomotive running is held under most hospitable conditions, in addition to smaller gatherings at other periods during the year. Mr. Friend's layout comprises a 620-ft. loop track, with gauges of $2\frac{1}{2}$ in. and $3\frac{1}{2}$ in. At the upper end of the loop there are two roundhouses connected to the loop by sidings and storage tracks large enough to



Mr. G. V. Purves, of Toronto, Canada, driving his 7 $\frac{1}{2}$ -in. gauge 4-4-2 type locomotive, taking a bend at speed.



Station buildings on the Madder Valley Model Railway of Mr. Ahern.



Putting the finishing touches to a fine model of St. Paul's Cathedral.

"Live Steamers" in the U.S.A.



"Live Steamers" at the home of Mr. Lester D. Friend, at Danvers, U.S.A.

accommodate all the engines brought for running. The roundhouses are roofed in and provide fuel and water facilities, inspection tracks, and good turntables. The Brotherhood is so widespread in its membership that sectional branches have been formed to enable local gatherings to be held. The group based on Mr. Friend's track is known as the New England Live Steamers. At their eleventh annual meeting in 1944 eighteen engines were under steam on the track, and nine others in various stages of completion were on show. Ninety-four members attended and thirteen different States were represented.

A prominent "live steam" enthusiast is the Rev. John D. Mahar, of St. Charles College, Eastonville. His forbears were all railroad engineers,

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and he himself has had some years of practical engineering experience, which now makes itself manifest in his love of miniature railway work. I am indebted to him for several of my "live steam" photographs.

Some Notable American Model Engineers

Scale model making is the principal activity of the Chicago Society of Model Engineers, and at their various exhibitions many beautiful examples of work have been on view. One of the stalwarts of this Society is Mr. John D. Matthews. English by birth but a resident for many years in that big city, his principal interest is locomotive building, and some years ago he made a visit to the mother country, bringing with him an engine which was a centre of interest at the *Model Engineer* Exhibition. The excellent performance of this engine under steam was recognised by the award of one of the much-coveted exhibition medals. This took place before the imposition of tariff regulations which now prevent overseas models from appearing at the Exhibition.

Mr. Matthews has built five locomotives in all, including $\frac{3}{4}$ -in. scale Atlantics and Hudsons, and a coal-fired "Rocket," which will operate on a few pounds of air pressure. The cylinders of this engine are $7\frac{7}{16}$ in. bore by $1\frac{1}{16}$ in. stroke, and the only castings used were for the cylinder blocks. Everything else is fabricated; that is, built up from pieces or cut out from the solid. In addition to the locomotives, he has also built two road engines and a steam roller, all coal-fired and modelled according to English practice. The largest of these is to a scale of 2 in. to the foot, and Mr. Matthews often takes it to Jackson Park under steam, towing a trailer filled with happy youngsters. All Mr. Matthews' family are interested in models. His son Roger has built a successful speed boat which gained several cups in regattas at Chicago and Detroit, and his daughter Charlotte specialises in making water-line ship models from Chinese junks to modern liners.

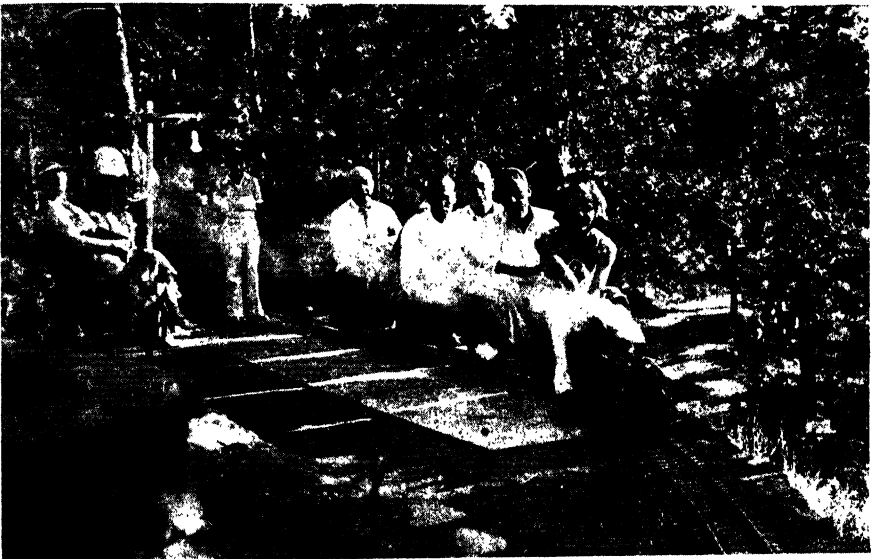
Another Chicago enthusiast is Mr. Howard Scott, whose interests range from locomotives to high-speed steam engines, petrol engines, model racing cars, steam yachts, and speed boats. He has built no less than six speed boats, and one of them has attained the very creditable speed of 40-41 miles per hour. His father is also a keen model engineer interested in both locomotives and speed boats.

The Rosenwald Museum of Science and Technology, in Jackson Park, on the shores of Lake Michigan, is comparable in its range of engineering exhibits with the Science Museum in London. It houses a number of prototype early American locomotives, rolling stock, fire-engines, motor cars, and aircraft, and a full-size replica of Stephenson's "Rocket."

Models in South Bend

There are engineering models in great variety testifying to the value placed on models by the authorities as a means of education and historical record. In one of the exhibition halls is a large model railway, in "O" gauge, occupying a site about 50 ft. square. This was originally made for the World's Fair in 1933 and was presented by the Aitchison, Topeka and Santa Fé Railroad. It is operated electrically and represents a typical American landscape in the Grand Canyon district of Colorado.

In the city of South Bend, well known among model engineers for its excellent lathes, there is a strong model-making fraternity. A prominent



Beauty takes control. A happy "Special" in New Orleans.

member is Mr. W. H. Weber, who has made a remarkable road engine to a scale of one-fifth full size. The model has been largely built from scrap material and was originally intended to be run by steam. Mr. Weber, however, found it necessary to modify his design and adapt it to electrical power. It is 46 in. in length and will easily haul a 70-lb. load of children. Mr. Bob Adams, of the same city, has excavated a basement, 40 ft. long, under his house, where he operates a complete model railroad in "HO" gauge. On this track everything is automatic, and many famous trains are represented.

South Bend is one of the centres of interest in model motor car building and racing, a branch of model engineering which has spread very widely

Model Engineering Overseas



On the "elevated," but not in New York.

in the United States. The local club has installed its own racing track just outside the city, and here exciting race meetings are a regular feature. The cars are run on a circular track, 70 ft. in diameter and slightly banked. Twenty-four laps equal one mile. Each car when running is tethered to a cable anchored to a ball-race on a central post.

Speeds of over 80 miles an hour are not uncommon, and the 100 m.p.h. figure has on occasions been exceeded. It is not surprising to find that enthusiasts have invented a name for these fliers—it is "spindizzies."

In other American cities the model engineering hobby grows apace. In Baltimore Mr. Pick specialises in making model guns of all kinds ; in Nills, Michigan, a local police executive builds petrol motors and miniature aero engines ; and in Grand Rapids Mr. Worjek, a *Model Engineer* reader, having built a number of reciprocating steam engines, is now engaged on a De Laval type turbine. A link with the *Model Engineer* Exhibition is to be found in the Smithsonian Institute at Washington, where, among many other models, there is a miniature of an Amorkeng fire-engine, built by Mr. F. A. Wardlaw. This was a prominent exhibit at the annual show in London in 1913, where it gained a silver medal and the special distinction of a gold badge. This was also before the days of Customs duties on imported models.

Down South, Mr. D. A. Warriner and his family, of New Orleans, literally bubble over with enthusiasm for model engineering. A fine 1½-in. scale saddle tank locomotive is in constant service on a picturesque garden track, and the family and their friends take a full measure of enjoyment from this home railroading in miniature. Mr. Warriner himself is a steam car "fan," and has built a special plant for driving his Dodge car. For eight years past he has driven a Stanley steam car, averaging from 500 to 1,000 miles a month.

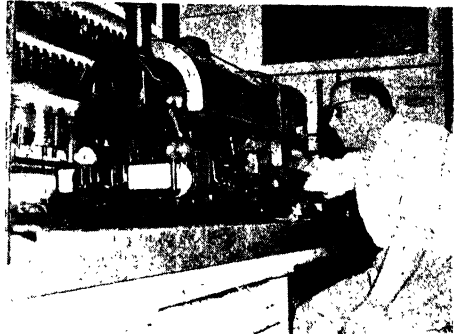


True to life. A splendid American model.

Canadian Enthusiasm

In Canada, with its much smaller population, the spirit of model engineering is no less alive. In Montreal and Toronto the steam locomotive is outstanding in its appeal and some very fine examples of design and craftsmanship are to be found in the respective societies in these cities. In Montreal the names and models of Mr. A. W. Leggett, Mr. C. F.

Harding and Mr. A. W. Massie are well known as indicating outstanding exponents of good design and craftsmanship and "live-steam" meetings under their auspices are always notable for fine performances on the track. Winnipeg also rejoices in its own Society, which can stage an exhibition of model making skill of the first order. Although one naturally turns to the big cities for examples of model engineering activity, many enthusiasts are to be found out on the prairie, their lonely life being made all the more enjoyable by the happy hours spent in their workshops and with their models.



Mr. D. A. Warriner adjusting his 1½-in. scale saddle tank locomotive.



Mr. Warriner gives a model railway garden party.

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Field-Marshal Smuts at the opening of the Sea Point Miniature Railway, at Cape Town.

Experts in South Africa

In South Africa the genius of the British race for mechanical engineering is well developed, and it is therefore not surprising to find that model making in all its forms has flourished exceedingly. In Cape Town, Johannesburg, and Durban particularly, model engineering societies are firmly rooted, and even as far north as Salisbury in Southern Rhodesia and in Nigeria, *The Model Engineer* has its devoted band of readers. In Johannesburg there lives Mr. George F. Perrem, a marine engineer by professional training, but now holding a high position in the Government telephone service. Mr. Perrem, with a splendidly equipped workshop, has been a model engineer for over 43 years and during this long period has built many admirable models. His latest effort is a $\frac{3}{4}$ -in. scale L.M.S.

goods locomotive, which gives excellent service on the track. But he is more than a model maker, he is the personification of hospitality and goodwill towards model engineers, and many a fellow-enthusiast on tour has found a most cordial welcome at Mr. Perrem's home. Johannesburg has been the scene of some notable model engineering exhibitions, usually organised by the Rand Society of Model Engineers on behalf of some benevolent or national fund.

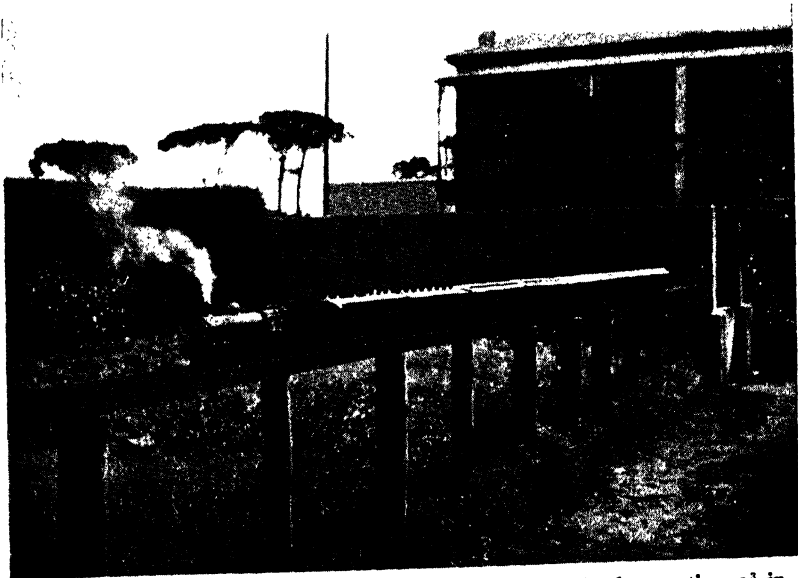
Cape Town is another centre of model engineering activity with a very live society to foster the interests of its members. The public enjoyment of the work of the model engineer is effectively catered for by the Sea Point Miniature Railway, which operates on a circuit of rather more than a quarter of a mile, on the sea front. The gauge is 5 in. and the passenger trains are hauled by a 4-6-0 locomotive of the Great Western "Hall" type. This railway is so popular that it has been quoted as furnishing the only example of queues in South Africa. It was opened by Field-Marshal Smuts, and on Saturday and Sunday afternoons scores of delighted

Experts in South Africa

youngsters, and grown-ups too, enjoy the thrills of a wonderful journey, which includes a tunnel on the way. An over-bridge forms a much-patronised viewpoint for spectators who want to see the fun.

Model Making in the "Bush"

In addition to the well-rooted enthusiasm for model engineering in the larger cities of the African continent there are practitioners of the hobby even in the wilds of the bush, where equipment and materials are hard to come by. Most of these folk are engineers whose professional duties in connection with railways, mines, or other undertakings require them to live in isolated and sometimes lonely places. Their hobby fills in their spare-time hours very agreeably, and often presents problems to them which the model engineer in the home country in easy reach of references and supplies never encounters. But the true spirit of the adventurer makes light work of these difficulties, and the joy of overcoming such obstacles to success is indeed great. Here, for example, is a little personal story in a letter from Mr. H. G. Horn, temporarily settled in Northern Nigeria. After a tour in South Africa, where he met Mr. George Perrem in Johannesburg, and some of the model experts in Cape Town, he wrote to me :—



A garden railway at Cape Town. Mr. W. Schultz's 4-6-2 locomotive, 1½-in gauge, makes a long haul.

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"Since I came back from South Africa really and truly fired with locomotive enthusiasm, and bringing with me drawings for a $3\frac{1}{2}$ -in. gauge 'Royal Scot,' I have got two other fellows out here also enthused. All three of us have started, sketches and dimensions being taken off my blueprints. The greatest snag is that castings are now unobtainable from home, but we have been able to scrounge sufficient sheet copper for two boilers. The third man is in charge of a machine shop which boasts of a small foundry, so he is going to do the needful for small castings. When we came to the tube part of the boiler we thought we should be sunk for the duration, as trying to find $\frac{3}{8}$ -in. copper tube of about 22 gauge thickness in Nigeria, and sufficient for two boilers, was just asking too much! Fortunately, we did find an old radiator off a compressor made entirely of dead straight lengths of $\frac{1}{2}$ -in. o.s. diameter solid drawn copper tube 16-gauge thickness. This indeed was a stroke of luck, and so pleased were we that, in a weak moment, I volunteered to skim down in my lathe sufficient tube to 21-gauge thickness, to do for the two boilers. What a job! But I got it done."

That surely is an example of enthusiasm overcoming difficulties. Some day I shall hope to see one or more of these Nigerian "Royal Scots" under steam.

In Northern Africa

In Nairobi, in Kenya, there is another hive of model engineering industry, presided over by Mr. F. Watts, who has not only set up a finely-equipped private workshop, but has laid out a passenger-carrying railway track, and built three locomotives. The workshop is notable for the fact that Mr. Watts has designed and built his own lathe and other machine tools. The railway is $3\frac{1}{2}$ -in. gauge and is built on sleepers laid down on a murram bed. This is a kind of hard earth containing iron ore, and when it has been wetted a few times, it sets like concrete. Mr. Watts' three locomotives are a small 0-4-0 Peckett-type tank, a L.N.W.R. "Precursor," and a "Hudson"-type 4-6-4 engine. These locomotives have all put up excellent performances on the track, which is a circular layout of about 350 ft. The little tank engine, which was built 13 years ago, can haul six adults round the track with ease, while the haulage power of the "Hudson" is only limited by the number of passenger cars available. At a Red Cross fête it pulled fourteen children and the driver on each trip, with very little effort. The three locomotives all work at a pressure of 100 lb. per sq. in.

Even the natives in some parts of Africa have felt the urge to follow in the steps of the white man and build models. That they are very neat

A Kenya Railway



Mr. Fred Watts, of Nairobi, drives his 3½-in. gauge. A well-balanced job!

craftsmen may be gathered from the picture I give of some native-made models of the stern-wheel steamers which serve the passenger traffic on the waterways of the Belgian Congo. These boats are constructed from a very light wood called "paletuviors," and are the work of native enthusiasts living on the borders of the Congo and Kasai rivers. It will be agreed that the proportions and effective appearance are very good.

Farther to the North-East the torch of model engineering has been enthusiastically carried by men serving in the Army and in the Royal Air Force, and model making has been welcomed as an agreeable relief from strenuous service duties in ordnance depots and aerodromes in

many isolated stations. It is on record that a soldier in the desert being short of something to read observed a printed sheet of paper fluttering in the breeze across the sandy waste. It proved to be some pages from *The Model Engineer*, and, as he perused his capture, he became enthralled with the account of the performance of a model locomotive. He thereupon decided that as soon as circumstances permitted, he would build one and get some of the fun. Thus model engineers are born, even in the most unlikely surroundings. In Palestine, Iraq and Persia, model hobbyists are scattered here and there achieving wonderful work with the limited time and materials at their disposal.

A Model "Hot Spot"

At Abadan, for example, about 40 miles north of the Persian Gulf, there is a group of enthusiasts whose productions include some excellent locomotives and aeroplanes, a fine model of H.M.S. *Victory*, and a working



A remarkable fleet of river steamers on the Congo, built by native "boys."

model traction engine. Owing to the climate, these activities can only be pursued during the cooler six months of the year, although some of the smaller bits-and-pieces may perhaps be dealt with if a cool and shady spot can be found indoors, during the hotter periods. These model makers are all engaged in professional engineering duties, but their love of tools and good craftsmanship impels them to devote much of their spare time to the model engineering hobby. So it is the world over.

Achievements in India

India has many such enthusiasts, and there is hardly a province in which one or more devotees are not to be found. Mr. T. S. Glover, of 48, Middle Road, Barrackpore, Calcutta, is a notable example. He has extended much hospitality to travelling model engineers who have found themselves within reach of his interesting home. As the result of the friendly contacts he has made with visiting model engineers, Mr. Glover conceived the idea of an East-India Model Engineering Society. In view of the great distances separating members, co-operation is carried on mainly by correspondence, but this circulation of experiences, with photographs and drawings, will establish a link between "lone hands" and will undoubtedly prove both helpful and agreeable. To assist in promoting this friendly intercourse, a Bulletin of notes and news has been

issued periodically to all members. Mr. Glover's principal interest is the building and running of model steam locomotives, but he recently constructed a fine model steam yacht, 5 ft. 10 in. long, which he named *Dunkirk* and raffled in aid of the funds of the Indian Seamen's Home. It realised £465, a splendid tribute to his enterprise, and to the practical value of his hobby.

On the other side of India there is the well-established Bombay Society of Model Engineers, which caters for enthusiasts in all branches of the hobby. The Chairman and leading enthusiast of this group is Mr. M. P. Polson, who is the owner of a very elaborate and complete model electric railway layout in gauge "O," which he constantly demonstrates to the delight and wonderment of his friends. The Bombay Society stages an annual exhibition of models which would compare favourably with similar exhibitions held in the home country, and never fails to attract a large and interested public.

Some of the native princes have brought the wonders of railway travel home to their subjects by the installation of elaborate working model steam railways. In the various service stations, where tools and materials are available, model engineering invariably finds some followers. A recent letter from a Corporal in the R.A.F. illustrates this very well. He says : " Although it has not been possible to form a club on this station, the active model makers have managed to get together to compare ideas. There are five of us actually working on models, and at least four more who would like to do so if conditions were more favourable." In a certain railway refreshment bar at an Indian station, R.A.F. Sergeant F. J. Roche was quietly reading a copy of *The Model Engineer*. The sight of the familiar journal drew a stranger to his side, who disclosed himself as a fellow enthusiast now engaged in building a locomotive. The R.A.F. Sergeant says : " In two minutes we were talking as if we had known each other all our lives, and I have now enjoyed most kindly hospitality at the home of my new-found friend." The stranger in question was Mr. Bibby, of Cawnpore, who after residence in India for seven years was building a 4-6-4 tank locomotive, with electric drive, for the edification of his sons. So the brotherhood of model engineering is ever-widening, a common interest in this fascinating hobby always forming an immediate basis of introduction and of lasting friendship in whatever part of the world the spark of enthusiasm may become visible. Model engineers in such tropical centres as India, Burma and Malaya have additional difficulties to contend with. Glue refuses to set, wood becomes warped, and, perhaps worst of all, work beautifully finished overnight becomes coated with a layer of rust by the arrival of the morning. Yet, despite these obstacles to

Model Engineering Overseas

success, the work still goes on, and eventually emerges as a triumphant tribute to the skill and patience of the builder.

Australasia to the Fore

Australia, New Zealand and Tasmania each have their model engineering societies, as well as many individual enthusiasts. Australia is particularly well represented by clubs at Sydney, Melbourne, Brisbane and Perth. The Sydney Society has achieved exceptional success through the assistance of a local benefactor which has enabled it to possess an imposing clubhouse containing a library, workshop, and commodious meeting room, an outdoor running track for locomotives, and a circular water "moat" which enables power boats to be run at speed. The club is a popular rendezvous for the younger generation of Sydney on high-days and holidays, when for a modest entrance fee they are admitted to see the wonders of the speed boats and locomotives at work. Mr. A. A. Stewart is a notable personality in Sydney model engineering circles. At his palatial home in the Blue Hills he has formed a remarkable collection of engineering models, including many of historic interest, and he also enjoys the advantage of a small private lake on which he can show the paces of his extensive fleet of model liners and warships. Some of Mr. Stewart's most interesting models are now on public view in the Sydney Technical Museum. Another staunch supporter of model engineering in Sydney is Mr. O. Burnaby Bolton, at whose establishment in King Street, model supplies of all kinds, both imported and of Australian production, are always available.

Melbourne is also a very live centre, not only of model engineering but of ship modelling, and practical hobbies of all kinds. So numerous are the local bodies which foster model making in one form or another that a Federation of Model Societies for the State of Victoria has recently been inaugurated. In Brisbane and its neighbourhood there are many model makers, prominent among whom is Mr. Henry Hart, of Salisbury. Ship modelling is Mr. Hart's special interest and he favours old-time sailing ships in particular. In his home he now has quite a museum of his productions, which includes true-scale models of such famous ships as *Cutty Sark*, *Pegasus*, *Wanderer* and *Mooltan*. He makes his own drawings and usually works to a scale of $\frac{1}{8}$ in. to the foot, which gives a model of a little over 3 ft. in water-line length.

Activities in New Zealand

New Zealand has always been a centre of much model engineering enthusiasm. Some of the early seeds of activity in this Dominion were

South American Enthusiasts

sown by Mr. Frank E. Powell, of Auckland, who, trained in the old Bow Works of the North London Railway, was my first editorial colleague on the staff of *The Model Engineer*. He not only contributed many practical designs and instructive articles to our early volumes, but wrote some of the popular handbooks in the well-known "Model Engineer Series." He later emigrated to New Zealand, where, after some years' service in the engineering department of the Auckland Harbour Board, he established himself as a Consulting Engineer. He has been responsible for the design of a number of important public undertakings in civil and electrical engineering, and has inspired many local friends with an enthusiasm for the model making hobby. In Dunedin the Otago Society of Model Engineers flourishes apace, and news frequently reaches me of their enterprising exhibitions and periodical meetings. One of their more active members is Mr. D. L. Scott, whose latest effort is a fine model of a triple expansion marine engine which occupied the spare time of two years in its building. There are many model engineers in the smaller townships of New Zealand, not perhaps sufficiently numerous in any one locality to establish a fully-organised society, but still in touch with one another and able to hold little group gatherings and to make an attractive display of their work at local agricultural and similar shows where there are classes for handicraft exhibits.

South American Enthusiasts

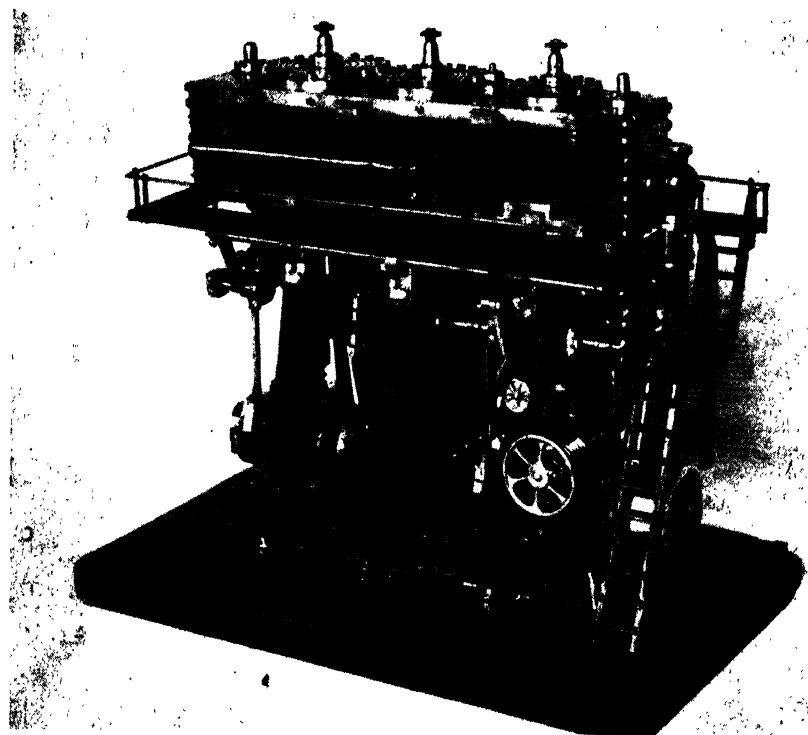
A number of individual enthusiasts are scattered over the countries of South America, but in Buenos Aires, in the Argentine, there is the nucleus of a real Society. A group of model engineers in that city, under the leadership of Mr. E. H. Roberts, have already built a fleet of model locomotives ranging in gauge from $1\frac{3}{4}$ in. to 5 in., and nearly every week-end these devotees of "live steam" meet together at the home of one or other of the members who owns a running track. The various engines are put through their paces, and the host for the day dispenses appropriate hospitality.

A Famous French Model Engineer

Nearer home there are many instances of the development of interest in models on the continent of Europe. In France and Switzerland there are several well-established model railway and power boat clubs, while before the World War enthusiasm in Holland was being aroused by the publication of a special journal for Dutch model makers. The language difficulty has doubtless in some degree retarded the spread of the influence of *The Model Engineer*, but despite this there are subscribers in most of the

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European countries. The story of French model making would not be complete without reference to the genius of Monsieur Gems Suzor, of Paris, who has acquired an international reputation for the construction and performance of his model speed boats. For several years between the war periods he was a regular visitor to this country to take part in the principal model speed boat regattas. He broke record after record, and delighted his fellow competitors with the novelty in design and meticulous construction of both the hulls and the petrol engine power plants of his



A fine triple-expansion marine engine by Mr. D. L. Scott, of Dunedin, N.Z.

series of boats, famous under the names of *Nickie I, II, III, and IV*. Not only did M. Suzor score many successes in the competitions, but with his good sportsmanship and engaging personality he became one of the most popular figures in the power boating world. With a true desire to encourage progress, he made no secret of his own improvements in design, but freely placed the details of his experience at the disposal of all who cared to enquire. Since the liberation of France he has been working

A Notable French Expert

assiduously to stimulate enthusiasm for model engineering in that country, and very gratifying success is attending his efforts. One practical result has been the formation of several flourishing model power boat clubs in the Paris area and elsewhere in France.

This rather rapid tour of the overseas model engineering world is necessarily very incomplete in its references to individual exponents of the hobby. I think, however, that sufficient has been said to show that, wherever a model engineer is to be found, there is both an enthusiastic love of good craftsmanship for its own sake and a determination to overcome whatever difficulties may exist through the absence of appropriate tools and materials. The model engineer at home has an ample choice of supplies of all kinds close at hand. His opposite number abroad has frequently to make shift with oddments, or to wait months before supplies can be imported from the mother country. But the same determination to succeed is there, and the admirable work which has been accomplished in the remote outposts of the Empire is a striking tribute to the fascination of the hobby and to the skill of its enthusiastic followers, wherever their duties or their circumstances of life may find them. Model engineering has truly achieved a world-wide understanding and appreciation.

XI

MANY DIVERSIONS

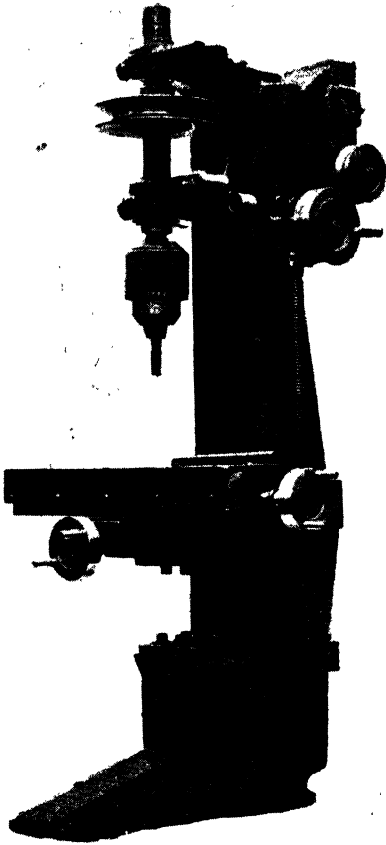
Some Miscellaneous Aspects of Model Engineering

ALTHOUGH so much of the material in this book relates to the modelling of engines or ships, it must not be supposed that this exhausts the range of activities of the model engineer. The love of craftsmanship and tools, the urge to make something, and possibly a wish to invent something new, are the dominating influences which result in the setting up of a home workshop. Frequently the desire to add to the amenities of the home inspires the model engineer in his efforts, and the construction and installation of an electric lighting plant, or a domestic refrigerator, or an electric washing machine are undertakings which have all been successfully achieved. The model engineer is the handyman of the household, and is expected to do all kinds of repairs to domestic equipment. Sewing-machines, clocks, mangles, and carpet-sweepers provide him with useful occupation, whenever he can be tempted to lay aside the work on his locomotive or petrol motor and attend to the little comforts of home life. But, in more serious vein, there are many directions in which the tools and skill of the model engineer are applied other than in the making of model engines.

Models in Research

Several of the model engineering societies have included the word "experimental" in their title, especially to cover the extensive scope of the hobby by their members. They make microscopes, astronomical telescopes, electric clocks, and scientific instruments, and, indeed, almost everything in which the working of metal is involved. To the ingenuity of the model engineer there is no end, and the private workshop has been the cradle of more than one important invention. Much progress in the early days of aviation was due to experiments with models, modern ship-building owes much to knowledge gained from the trial of models in experimental tanks, and in almost every branch of technical research and

A Novel Invention



A small vertical milling machine. A good example of machine tool making by a model engineer, Mr. F. Coleman.

technical education models play a part.

Each step forward in scientific discovery brings possibilities of interesting construction and experiment to the model engineer. The arrival of the cinematograph aroused interest at once, and many very efficient home projectors are in use which owe their birth to the existence of a model workshop. The model engineer is something more than a constructor ; he is a student, and the range of the engineering and scientific knowledge possessed by many hobbyists is often surprising. Indeed, as I have already mentioned, many model engineers were able during the World War to enrol in laboratories and munition factories and by their knowledge of tools and instruments and their clever handicraft they contributed in no small degree to the total war effort. This was of particular value in tool making, and in the maintenance and repair of scien-

tific instruments. Many model engineers have graduated from the amateur to the professional ranks with success, and in several cases have achieved a position of independence through the establishment of their own manufacturing business.

A Novel Invention

An unusual example of enterprise of this kind came to my notice some years ago. A reader of *The Model Engineer*, then engaged in a

Many Diversions

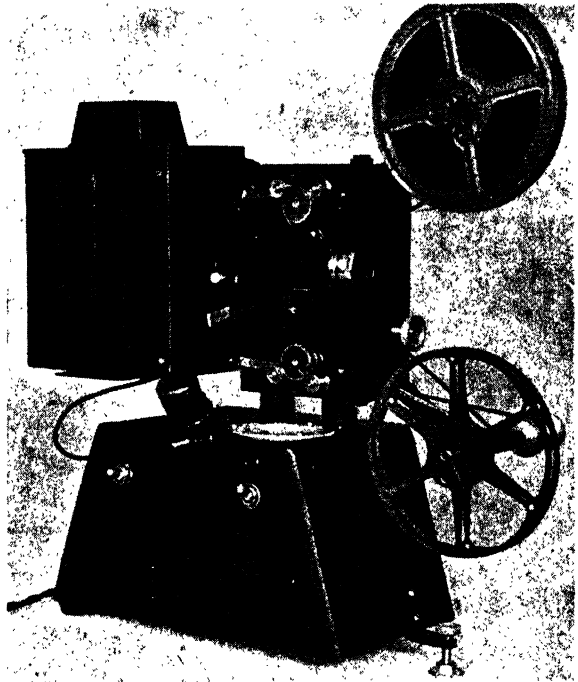


A roadside attraction. A model of the famous Alford (Lincs.) tower windmill made by Mr. Sleight, of Doncaster. Scale $\frac{1}{4}$ -in. to the foot

clerical occupation, devised a novel "penny-in-the-slot" mechanism to be applied to telescopes. His idea was that a number of telescopes so fitted should be installed at popular seaside and scenic resorts, so that the public, by the insertion of a coin, could enjoy the use of the telescope to view the shipping or other interesting objects. He purchased a lathe and some tools, and a handbook on metal turning. With this equipment and his own natural mechanical genius, he proved the efficiency of his design, and proceeded to manufacture his telescopes. The venture proved a great success. This little story aptly illustrates the inherent mechanical ability which is so characteristic of the British race, and finds so wide and beneficial an outlet through the hobby of model engineering.

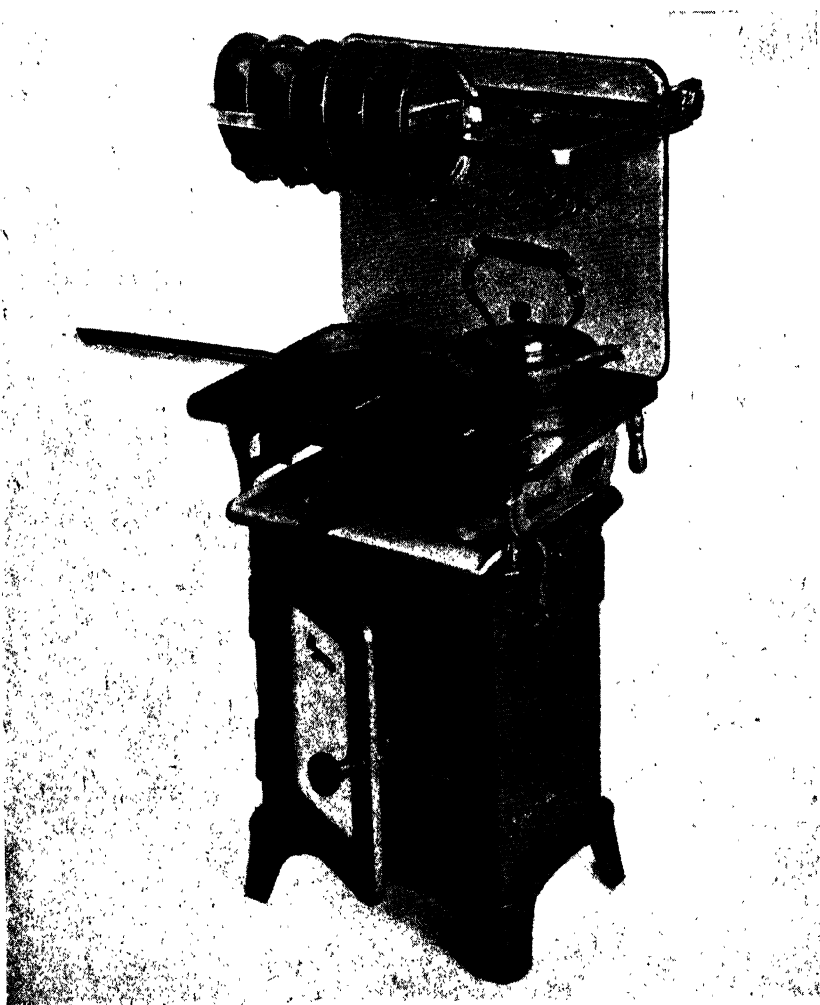
I should like to quote two other unusual departures from strictly engineering prototypes for which the late Mr. H. O. Clark, of Norwich, was responsible. The first of these was a perfect scale model of the windmill of the post type which formerly stood at Sprowston, in Norfolk. The mill itself was destroyed by fire in 1934, but its memory will always be preserved by Mr. Clark's

beautiful model. The model itself, on which Mr. Clark spent some fifteen years of his leisure time, is one-twelfth full size. So determined was Mr. Clark that his model should be perfect in every respect that he spent endless hours in the patient measurement of every detail of the original. The other example of Mr. Clark's ingenuity and his interest in history was his model to demonstrate the method by which the ancient Egyptians erected their imposing and enormously heavy obelisks. By this model, Mr. Clark could show how these monuments



A home ciné-projector for 8 mm. films, made by Mr. A. C. Jolly, of South Africa.

Many Diversions



Domestic equipment sometimes inspires the model maker. This realistic model of a gas cooker, made by Mr. T. A. Rosbottom, is only one-fifth actual size.



A future locomotive engineer. A young enthusiast on the Ken View model railway.

were first dragged up a slope of earth or sand, then tilted over at the top, and lowered into a pit containing the base on which they finally rested.

Mr. J. Adrian Hands, the Town Clerk of Dorchester, is yet another model engineer who has applied his private workshop and his great mechanical skill to a useful purpose. His Council were anxious to erect a carpenters' workshop in a certain position in a yard but were doubtful if the space available was sufficient for the purpose. Mr. Hands thereupon built a model of the proposed workshop to show that it could be done. Not only did his model of the building solve the

problem, but he went so far as to reproduce all the necessary equipment in miniature with lathes and tools that actually worked. In similar circumstances he produced a most complete model of an engineering workshop fully equipped with lathes and machine tools. These two models are illustrated in Chapter II. Mr. Hands has always been an advocate of originality and utility in model making, and he has certainly demonstrated his views in a very practical way.

Tool Making

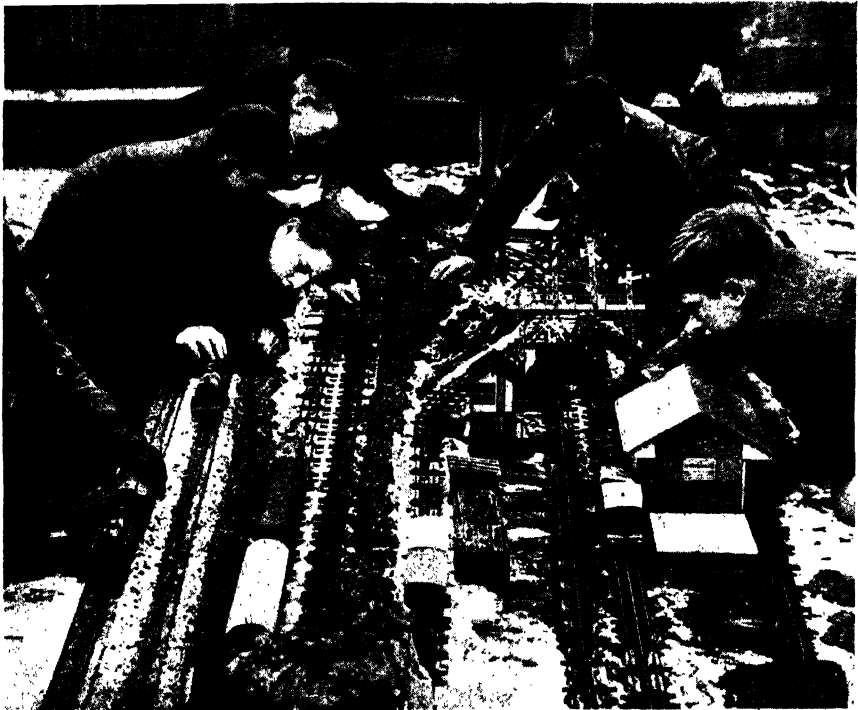
No review of the activities of model engineers would be complete without some reference to their skill as tool makers. Despite the very complete array of both machine and hand tools offered by trade firms, the model engineer often finds himself in need of a special tap or milling cutter or some other tool essential for the job in hand. He proceeds to make one, and often finds as much enjoyment in work of this kind as in his actual model making. But with many enthusiasts his adaptability goes far beyond the making of an occasional small tool. He will make useful additions to his lathe, such as milling and drilling fixtures, dividing heads and special chucks, or will add screwcutting gear to a plain lathe

Many Diversions

or an overhead drive. He will build his own drilling, milling or shaping machines, and even at times his own lathe. He is truly a master of mechanics in miniature, for no problem involving the use of tools and metals to a small scale is beyond his successful solution.

Demonstration and Utility Model Engineering

There are numberless instances where model engineers have lighted their houses electrically, have installed equipment for water supply, have built motor cycles and motor cars, and in other ways have applied their skill and their workshop equipment to the service of their families and friends. Whether the installation called for steam or petrol engines, windmills, pumps or water-motors, dynamos, or electric motors, or other gear, the model engineer approached the problem with confidence and, having succeeded in achieving the desired result, he was in the proud position of being able to say, "It's all my own work."



These are the keen young model makers who operate the Ken View model railway.

A War-time Souvenir



A souvenir of the Second World War. The model is one-sixth full size.

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**A general view of the well-known Bekonscot Model Village at Beaconsfield.
Note the men working on the model houses.**

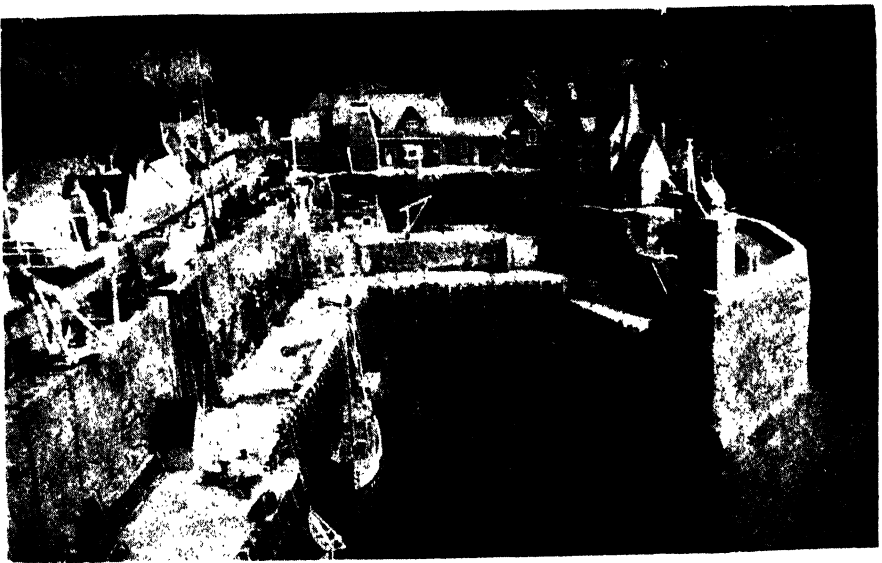
Model Engineering for Benevolent Purposes

The benefits of model making are not always confined to the hobbyist himself. Exhibitions of his work are frequently arranged for benevolent purposes, and many Red Cross, hospital and other public-service causes have derived considerable financial help from the proceeds of such displays. An exhibition of models invariably attracts the public, both old and young, and the modest admission fees charges on these occasions mount up to very substantial figures. In the London area there are two examples of most interesting permanent displays which have contributed handsome sums to charitable institutions. These are the Ken View Model Railway in Bishops Avenue, North Finchley, and the Bekonscot Model Village at Beaconsfield. The former of these is a complete model railway, planned and supervised by Mr. A. G. Beach, who enlists the help of local boys for the operation and maintenance of the system. The railway not only contributes substantially to the local hospital through the donations of visitors, but is of distinct educational value to the young helpers, who

A Model Harbour

are most enthusiastic and capable in their duties. At Beaconsfield, Mr. Roland Callingham, of Warwick Road, has laid out a complete model village on ground adjoining his garden, and in addition to the attractive miniature buildings it incorporates a working model railway and a waterway for model ships. The village is open for public inspection during the summer months, a small charge is made for admission and the proceeds are devoted to one or other of the railway benevolent institutions in which Mr. Callingham is interested. Many of the model engineering clubs having portable passenger-carrying railway tracks, visit fêtes arranged for charitable purposes and demonstrate their locomotives to the huge enjoyment of the younger generation.

Models are widely used in schools for educational purposes, and these are often made by the children themselves, either at home, or in the school workshop. A teacher once told me that he took a great interest in encouraging handicraft, and particularly model making, in his school. He found one boy, however, who could not raise the slightest enthusiasm for the workshop. His whole mind was absorbed in the study of literature and the drama. Then the teacher made a happy suggestion. "Why not make a model theatre?" he said, "then you could bring to life some of the plays in which you are so deeply interested." The boy responded at



A perfect model harbour in full detail.

Many Diversions

once. He attended the handicraft class, built his model theatre, and both teacher and pupil were satisfied with the result.

Models in the World of Commerce

Although not strictly within the hobby limits of model engineering, some reference may be made to the ever-growing use of models in the commercial world for exhibition and demonstration purposes. Many machines and other trade productions can be shown in model form where for reasons of space or transport difficulties the full-size article cannot be placed on view. The layout of factories, docks, harbours and estates can be reproduced in miniature, and architectural and town-planning schemes can be admirably presented in model form. Most of this kind of model making is the work of professional firms, but it often happens that the ingenuity and skill of the amateur craftsman is called into service. During the world war a very large number of models of all kinds were required for training purposes, and provided opportunity for many model engineers in the ranks to turn their hobby to useful account in the war effort.

The Recreation of Professional Engineers

It might be imagined that professional engineers would seek some other occupation for their leisure hours than that afforded by a home workshop. Yet it is a fact that many engineers turn to model engineering or some form of mechanical handicraft, as a hobby. Engineering is in their blood, and they find enjoyable recreation in spending their spare-time hours in company with their beloved tools. The famous James Watt had a well-equipped private workshop in which several of his ingenious, though perhaps lesser-known, inventions first came to light, and James Nasmyth, Sir Henry Bessemer, Louis Brennan, and other master mechanics of their time found the benefit of seclusion and contemplation when surrounded in private by the lathes and tools which enabled them to bring their ideas to practical fruition. In more modern times many leaders of the engineering profession have found recreation and health in their home workshop. In nearly every model engineering society there are engineers whose hobby, as well as their profession, is engineering, and it is perhaps unnecessary to say that their technical knowledge is freely available for the general good. The practice of model making as a hobby has often proved a stepping stone to agreeable engineering employment. Instances have occurred where the display of a model made at home has led to the offer of a suitable post in an engineering works. The latent mechanical ability of the model engineer has been readily recognised by the prospective employer, with mutually satisfactory results.

The Reward of the Hobby

The general survey of model engineering as a hobby presented in this book will, I hope, lead to a greater appreciation of its value both as a recreation and as a stimulus towards technical progress. It has not been possible in the space of a single volume to do more than discuss the broad aspects of the subject, illustrated by some concrete examples of work achieved by its devotees, but if my writing encourages some of its readers actively to explore this fascinating realm of mechanical adventure, I am sure they will reap a rich reward of both good health and agreeable occupation, and will contribute much to the interest and enjoyment of their friends. To all model engineers, wherever they may be found, I wish the fullest possible measure of happiness and success.

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